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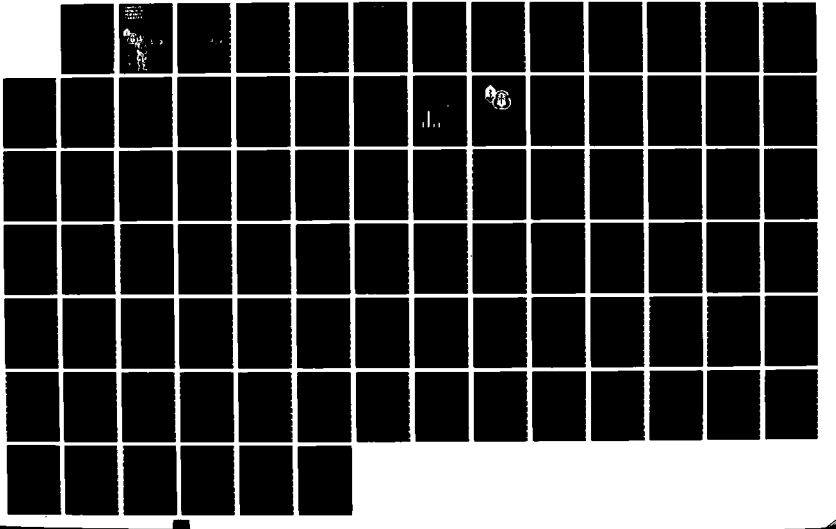

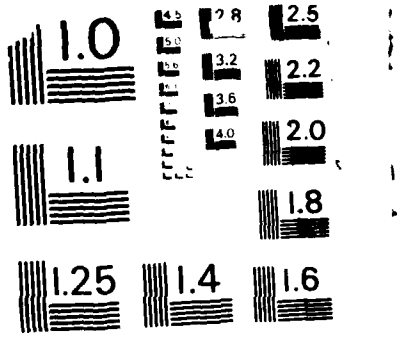

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UNITED STATES ARMY MEDICAL BIOENGINEERING RESEARCH & DEVELOPMENT LABORATORY

Report MEDDH-288 (R1)

ANNUAL PROGRESS REPORT
1 October 1985 - 30 September 1986
VOLUME I

FORT DETRICK, FREDERICK, MD. 21701-5010

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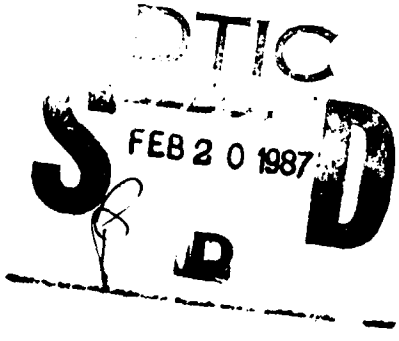

REPORT MEDDH-288 (R1)

U.S. ARMY MEDICAL BIOENGINEERING RESEARCH AND DEVELOPMENT LABORATORY, ANNUAL PROGRESS REPORT FY86, VOLUME 1

U.S. ARMY MEDICAL BIOENGINEERING RESEARCH
AND DEVELOPMENT LABORATORY
Fort Detrick
Frederick, MD 21701-5010

1 October 1986

Annual Progress Report for Period 1 October 1985 - 30 September 1986

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US ARMY MEDICAL RESEARCH AND DEVELOPMENT COMMAND
Fort Detrick
Frederick, MD 21701-5012

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19 ABSTRACT (Continue on reverse if necessary and identify by block number)

The Annual Progress Report, Fiscal Year 1986, summarizes in two volumes the research performed by the U.S. Army Medical Bioengineering Research and Development Laboratory in projects authorized by The Surgeon General, the Army, and the Commander, U.S. Army Medical Research and Development Command, and supported by RTDE funds from the U.S. Army Medical Research and Development Command.

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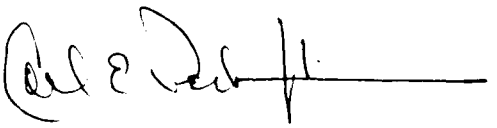
INTRODUCTION

The U.S. Army Medical Bioengineering Research and Development Laboratory's (USAMBRDL) is a small but highly efficient subordinate unit of the U.S. Army Medical Research and Development Command (USAMRDC), located at Fort Detrick, Maryland. The USAMBRDL is the only laboratory to perform research and development efforts within all of the parent Command's research areas. In effect, USAMBRDL may best be characterized by broad mission responsibilities being met by a diversified, multidisciplinary team of scientists and engineers performing basic and applied research and development ranging through all program categories 6.1 - 6.4. The overall mission focuses on the protection of soldiers in combat and training scenarios, military and civilian employees in Army-unique industrial exposure settings, and protection and enchancement of the environment.

The USAMBRDL, established just over a decade ago by the merger of three separate Army laboratories, is deeply committed to the soldier and the environment not only by mission responsibilities but also by the efforts of a dedicated staff. We are moving with the sure steps of a firmly established research organization of the 1980's to the needs of the Army in the 1990's and beyond.

Trends and accomplishments are highlighted in Volume 1 of this report while all research and technology summaries (1498s) are presented in Volume 2. Detailed individual and contractor's research is synopsized in reports which are filed with the Defense Technical Information Center (DTIC).

Questions or comments about this report are welcomed and may be addressed to the Commander, USAMBRDL.



CARL E. PEDERSEN, Jr., Ph.D.
Colonel, MS
Commanding

MISSION

The USAMBRDL conducts basic research in the areas of field medical materiel, vector control systems, health hazard assessments and environmental health effects. It also develops or modifies, tests, and evaluates field medical, dental, and water treatment equipment and technologies and develops vector control and field sanitation methods, materials, and equipment to meet military needs; establishes atmospheric and water related health hazard data bases for occupational and field exposures to chemicals and microorganisms; provides exposure guidance and recommends criteria and develops and recommends environmental criteria and pollution abatement procedures for chemical substances from Army industrial and field oeprations. In addition, USAMBRDL provides research, consultation, and technical services to the Army and other Federal agencies as requested.

SUMMARY OF SIGNIFICANT IMPROVEMENTS

This was a year of major program expansion, enhanced productivity, and well deserved recognition. The USAMBRDL research programs produced significant new data, and new program additions to existing activities greatly advanced medical linkages to and support for key Army readiness requirements. FY86 was also a period of personnel and organizational change and facility realignment to address new research thrusts and more effectively and efficiently develop and employ research methods to support protection of the soldier, military industrial workers, and public health. Finally, FY86 was a period for remarkable individual achievements paralleling the significant productivity and improvement in methods to address new mission issues. Specific major improvements in the performance of this Laboratory during FY86 (detailed elsewhere herein) are itemized:

USAMBRDL program thrusts were refined to direct efforts toward effective resolution of Army readiness issues.

USAMBRDL was named as the lead agency by the U.S. Army Troop Support Command for rapid response to medical materiel needs for Special Operations Forces.

USAMBRDL efforts in the Army space initiative are progressing rapidly toward development and fabrication of unique equipment for *in vitro* healing studies in space.

Directed combat casualty care has focused on more rapid fielding of medical materiel developed for the field soldier.

Expansion of alternative species research program is providing the Army with the capability to perform toxicology studies more rapidly, at substantially reduced costs, and with significantly lessened public concern for test species welfare.

The Laboratory was reorganized to a structure with clear and understandable lines of authority and responsibility.

Occupational health reimbursable funding was acquired from the materiel and weapons development community in response to new health hazard assessment policies. Recognition of need through medical research program growth reflected the payoff of a developing research program becoming fully functional.

Refined a research program in medical defense against chemical warfare agents and trichothecene mycotoxins in field water supplies. Identified methods for detection, identification, quantitation and detoxification of these substances in water. In addition, the existing data base for development of adequate water quality criteria was improved.

Active research was continued or initiated through national laboratories of the U.S Department of Energy, and with national laboratories of the U.S. Environmental Protection Agency, U.S. Food and Drug Administration, and the National Institutes of Health.

In-house research capabilities were expanded to meet new requirements for research in conventional weapons combustion products. This involved development of field instrumentation for measurement of hydrogen chloride, a corrosive compound produced by Army weapon systems which use perchlorate-based propellants.

The preliminary pollutant limit value (PPLV) concept, developed by USAMBRDL researchers to predict probable environmental limits for pollution in soil and water, served as a key focal point for scientific exchange and a framework for environmental research decision making. These efforts are a part of proposed legislation in the Congressional Record (PH 8156) and are serving as a basis for support in major Army litigation defense.

New research was initiated to address contaminant health hazards and workplace protection needs associated with the production, use, and disposal of combat weapons and materials.

Substantial progress was made in research efforts to identify the risks of teratogenesis for personnel who may be occupationally exposed to low concentrations of agents VX, GB, GD, HD, and L during demilitarization operations.

USAMBRDL addressed "Technology of the Soldier" by presenting research and development strategies, efforts and accomplishments on the "Pesticide Dispersal Unit, Multicapability, Helicopter Slung" at Army Science Conference at West Point. The data was developed and assembled and a paper presented by the Principal Investigator, SGT Michael R. Sardelis, the first noncommissioned officer to present at United States Military Academy, West Point.

In-Process Reviews were convened resulting in acceptance of recommendations for type classification, standardization, or transition to the appropriate activity of several items of medical hardware for acquisition and fielding.

Enhancement of organizational relationships with other Army and Department of Defense and Federal agencies includes:

Memorandum of Agreement with the U.S. Army Troop Support Command to enhance USAMBRDL's capabilities to field equipment in the broad area of preventive medicine.

Designation of USAMBRDL as the Defense Construction Supply Center's primary laboratory for conducting first article testing of all items of equipment procured by this Center under Federal Supply Code 3740 to accelerate the fielding of new equipment.

Selection of USAMBRDL by the Defense Personnel Support Center to conduct first article testing to ensure that the field Army will receive the very best equipment obtainable.

Memorandum of Agreement with the U.S. Environmental Protection Agency to provide a formal mechanism for the development of health advisories for military-unique chemical substances in drinking water.

Establishment of a separate and independent entity within the organization to gain and maintain cognizance of the total extramural program for the entire Laboratory.

Completion or initiation for assured completion of minor construction projects to convert, under existing roofs, 8,388 square feet of usable work or secure storage space.

Execution of in-house budget with obligations above USAMRDC target at 94 percent and disbursements comfortably above target at 80 percent.

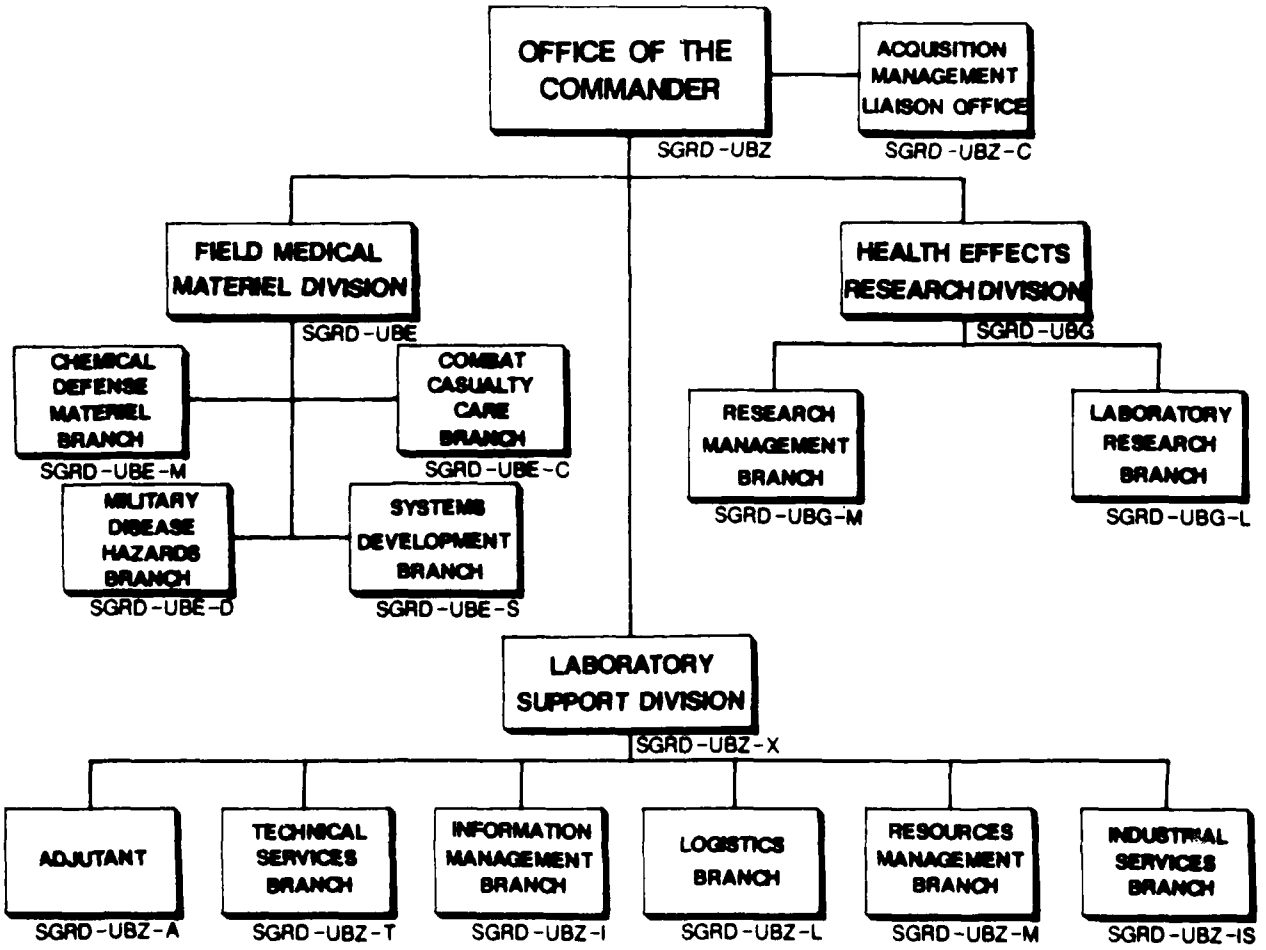
Four Career Service Awards and recognition of FY86 individual research achievements and awards exemplify the professional character, responsiveness, productivity, and quality of USAMBRDL staff and research programs.

The prominence of individual achievements was underscored by the attainment of advanced degrees by two civilian staff members, and the selection of a military member as U.S. Army Medical Research and Development Command Soldier of the Year and Fort Detrick Soldier of the Year for 1986.

DESCRIPTION OF USAMBRDL AND ITS CORE PROGRAM

ORGANIZATION

The USAMBRDL organization is graphically presented below. The Office of the Commander, and support offices for administrative services, engineering evaluation, information management, logistics, resources management services, and contracts administration/quality assurance comprise the headquarters element.



The Field Medical Materiel Development Division is the principal operating element in support of USAMRDC in performance of its mission as medical materiel developer. Primary division activities involve the conduct of in-house and extramural research and development of medical, dental, and vector control materiel for use in conventional and chemically contaminated environments. It coordinates an integrated pest management program,

constructs initial prototypes and test models, produces limited quantities of medical materiel to support urgent military requirements, and provides the medical materiel developer's portion of the Life Cycle System Management Model and the Product Improvement Program.

The Health Effects Research Division performs the primary research mission of developing biomedical data for recommending environmental quality and occupational health protection criteria for military-relevant contaminants; and conducts health hazard assessment research for Army materiel acquisition programs. Primary Division activities include conduct of comprehensive basic and applied research in support of The Surgeon General's responsibilities in environmental quality protection to include air, land, and water pollution control and disposal of hazardous/toxic wastes and pesticides; and The Army Surgeon General's responsibilities in occupational health protection associated with Army personnel exposures to chemical hazards of military systems and operations, and exposures to chemical, biological, radiological, and chemical agent contaminants associated with field water supply and sanitation.

Organizational Improvements:

- Particularly noteworthy as an improvement within the headquarters element was the establishment of the Acquisition Management Liaison Office (AMLO). This Office was formed to administer extramural research efforts, previously not centrally controlled nor monitored, and to establish the regulatory audit trails and scientific reviews necessary to ensure the quality and integrity of this Laboratory's research programs. This Office provides progress and budget information used by the Commander and staff to establish long-range objectives and to adjust priorities. Historical reference files have been organized to include all contract documentation; research plans and scopes of work; protocols and standard operating procedures; monthly, interim, and final reports; and internal and external scientific reviews. Current efforts by this Office include the establishment of a fully automated external research monitoring system and a fully automated internal research monitoring system that can be used to better manage personnel and dollar assets.

- For the past several years this Laboratory has operated an overall program for the management and integration of information resources. The result of this program is a local network of over 80 personal computer based workstations with associated shared mass storage, printing, and communications resources. Each workstation is configured as required by the local functions it supports, and the network provides central control of shared peripherals. In addition, data security is centrally managed, and communication gateways to both Command installation remote data centers are provided. Word processing, data base management, graphics, process control, project management, spreadsheet, and a variety of programming languages are all supported within the framework of a common user interface. It is significant to note that the plans and program which produced this system predate the current Army guidelines. However, the system is consistent with these guidelines in both concept and architecture. It is also consistent with the major trends in industry and academia.

FACILITIES

The mission of USAMBRDL is carried out in eight separate buildings on Fort Detrick, consisting of 111,868 square feet of floor space. Building 568 serves as the headquarters of the Laboratory and in addition houses entomology laboratories for studies in controlled release pesticides, integrated pest management of mosquitoes and black flies with two insectaries, electron microscopy facilities, and an extensive aquatic toxicology laboratory. Building 524 serves as the administrative facility for coordination of the extramural research program in occupational health and environmental quality. Building 459 is the laboratory for in-house research efforts supporting the Health Effects Research Division in microbiology and chemistry. Building 1054 serves as the fabrication facility of the Laboratory where prototypes and test models of equipment are produced and undergo engineering evaluation and durability testing. The facility includes a drafting room, an electronics shop, heavy and sheet metal shops, woodworking shop, fabric shop, paint shop, and foundry. This building also houses an advanced wastewater treatment pilot plant. Building 1056 is the center for engineering evaluation and durability testing of pesticide dispersal equipment proposed for military use.

During the year, the USAMBRDL studied the use of real property and conducted trade-off analyses with respect to renovation and relocation alternatives. This effort was initiated to take advantage of space that needed minor renovation and to avoid the cost of renovating facilities where costs were prohibitive. The result of this planning was the relocation of the Logistics Branch and initiation of renovations for in-house laboratory facilities. This movement saved 50 thousand dollars in the near term and may have saved over a million dollars in long-range improvements which were needed to satisfy the Occupational Safety and Health Administration requirements for Building 459, a building which did not meet standards for the work being performed there. The relocation also generated the time and space necessary to remove an asbestos hazard from Building 459.

The quality and complexity of the research being conducted at this Laboratory have increased substantially over the last year. This was due primarily to the renovation of the insectary and labs and an increase in the number of computers available to researchers. The insectary was compartmentalized with individual rooms having temperature and humidity controls. These environmentally controlled rooms provide capability to rear different species of arthropods. Additionally, a water chiller was installed to allow rearing of blackflies. Computers have been placed in the laboratories, and computer monitoring of insect colonies and rapid analysis of data have had a marked impact on productivity.

Other relocations have been planned to consolidate functions and permit the best arrangement for the fewest dollars. For example, the number one priority is to relocate the Materials Test Laboratory from Building 568 to Building 1054. This move makes prime laboratory space available for the two operant research divisions and colocates all of the engineering evaluation functions into one area.

PERSONNEL, MANPOWER AND FORCE STRUCTURE

Personnel

During FY86, USAMBRDL operated with an authorized staff of 119 professional, technical, and support personnel specialized in a wide range of scientific and engineering disciplines, experienced in both in-house and extramural research management, and supported by state-of-the-art laboratory equipment. The USAMBRDL provides a unique research organization for support of Army activities burdened with problems in the broad areas of combat casualty care, human health effects of environmental pollution, preventive medicine, and medical aspects of chemical defense.

Professional disciplines represented in the organization include:

- Aquatic Biology
- Biology
- Biomedical Maintenance
- Biostatistics
- Chemistry
- Computer Sciences
- Dentistry
- Drafting
- Engineering
- Entomology
- Environmental Health Sciences
- Microbiology
- Medical Illustration
- Nursing
- Physiology
- Toxicology/Pharmacology
- Trades and Crafts
- Veterinary Medicine

TABLE 1. USAMBRDL FY86 STAFFING

	Required	Authorized
Officer	18	15
Enlisted	15	14
Civilian	123	90
TOTAL	156	119

The USAMBRDL managed personnel assets carefully throughout the year and met Civilian Employment Level Planning and Annual Funding Targets even in the face of authorization decrements for both military and civilian personnel. One method of prudent management was to actively recruit and employ the appropriate mixture of special category personnel from the following:

DoD Science and Engineering Program
Summer Hire Students (contract)
Faculty Research and Engineering Program
Laboratory Research Cooperative Program
Volunteer Program
Stay-In-School Summer Aid Program
Temporary and Part-Time Employment

The USAMBRDL was extremely fortunate to have an opportunity to select and employ a first-rate research and support staff using the talents and energies of these educated and productive personnel. They filled the gaps both professionally and administratively and satisfied the demands for both work years and talent for major research efforts in the Laboratory.

Training

During the year the USAMBRDL made significant training and education experiences available to the staff. Well beyond the scope of conference and seminar training, the USAMBRDL was able to provide training at the Combat Casualty Care Course; the Army Logistics Management Center; the Office of the Deputy Chief of Staff for Research, Development and Acquisition; and Department of Defense seminars sponsored by the Office of Management and Budget. These are significant improvements not only because of the level of training which was provided but also because of the level of effort required to obtain quotas for the sessions. Additionally, 100 percent of the eligible enlisted personnel received training at major Training and Doctrine Command Schools for platoon leader development and noncommissioned officer development, education, and training.

The USAMBRDL continued with its initiative to provide scientific and engineering symposia to introduce and maintain several critical scientific, management, and administrative topics for the integrated staff.

The USAMBRDL staff also received training in security and in hazardous materials management. This "Right to Know" and "Materials Safety Data Sheets" training was nearly a year ahead of the Department of the Army requirement and served as a model for the installation.

During FY86, job-related training was provided to 69 civilians and all military personnel of the USAMBRDL to include administrative and managerial development, secretarial and clerical training, and wide range of technical courses in the biological and physical sciences; mathematics, statistics, computer operation and programming; and communication skills.

Occupational and Environmental Medicine Residency Program programmatic support to the U.S. Army Environmental Hygiene Agency's (USAEHA) Physician Residency Program was formalized by a memorandum of understanding. This 1-year physician residency program, leading to board certification, involves a candidate's extensive involvement in military occupational and environmental health issues and programs and completion of a residency project.

Manpower and Force Structure

During 1986, the USAMBRDL presented a comprehensive Five-Year Plan to the Commander, USAMRDC. This document represented an intensive review of current programs and resource utilization based upon USAMRDC guidance and current execution. Projections were scheduled based upon the best estimates of projects to be performed in-house and by extramural contract and the fiscal and personnel resources that were available or required to meet the Research, Development, Test and Evaluation (RDTE) program needs for the next 5 years.

One result of this program was the functional requirement of the extant work force to support the execution of the Five-Year Plan. This document was presented to the Command Manpower Survey Team which certified the current proposed utilization of human resources. The functional realignment resulted in major changes for the Field Medical Materiel Development Division which now has functional branches that directly reflect each of the USAMRDC Research Area Director work units in:

- Military Disease Hazards
- Combat Casualty Care
- Chemical Defense Materiel

While most reorganizations are relatively unexciting, this new functional arrangement is noteworthy because it is completely work load driven. It follows a logical planning sequence:

1985 - Initiated first Laboratory-wide Review and Analysis with follow-up Strategic Planning.

1985-1986 - Continued Review and Analysis with a first-ever comprehensive Five-Year Plan.

1986-1987 - Refined Review and Analysis process and updated the comprehensive Five-Year Plan.

FUNDING

During 1986, the USAMBRDL continued to make significant progress with respect to zero based, project line funding. By skillful reprogramming, the USAMBRDL was able to reconstitute available funds and align all projects and tasks within the major Research Area Director priority list and support ongoing but underfunded tasks at the Laboratory. A task force of division chiefs, the resource manager, and the Commander carefully aligned manpower authorizations, civilian employment level plan target, and work years of effort for each Research and Technology Work Unit Summary (DD Form 1498) and provided a Commander's operating budget estimate which represented realistic work units, their true costs, and which were clearly subject to audit. This funding initiative resulted not only in the proper alignment of funds but also rendered further reprogramming with facility without significant risk or adverse personnel actions. This reprogramming also met the new guidelines in AR 70-6 approximately 6 months ahead of schedule and made Headquarters, USAMRDC, directed manpower reductions easier to absorb without reduction-in-force actions.

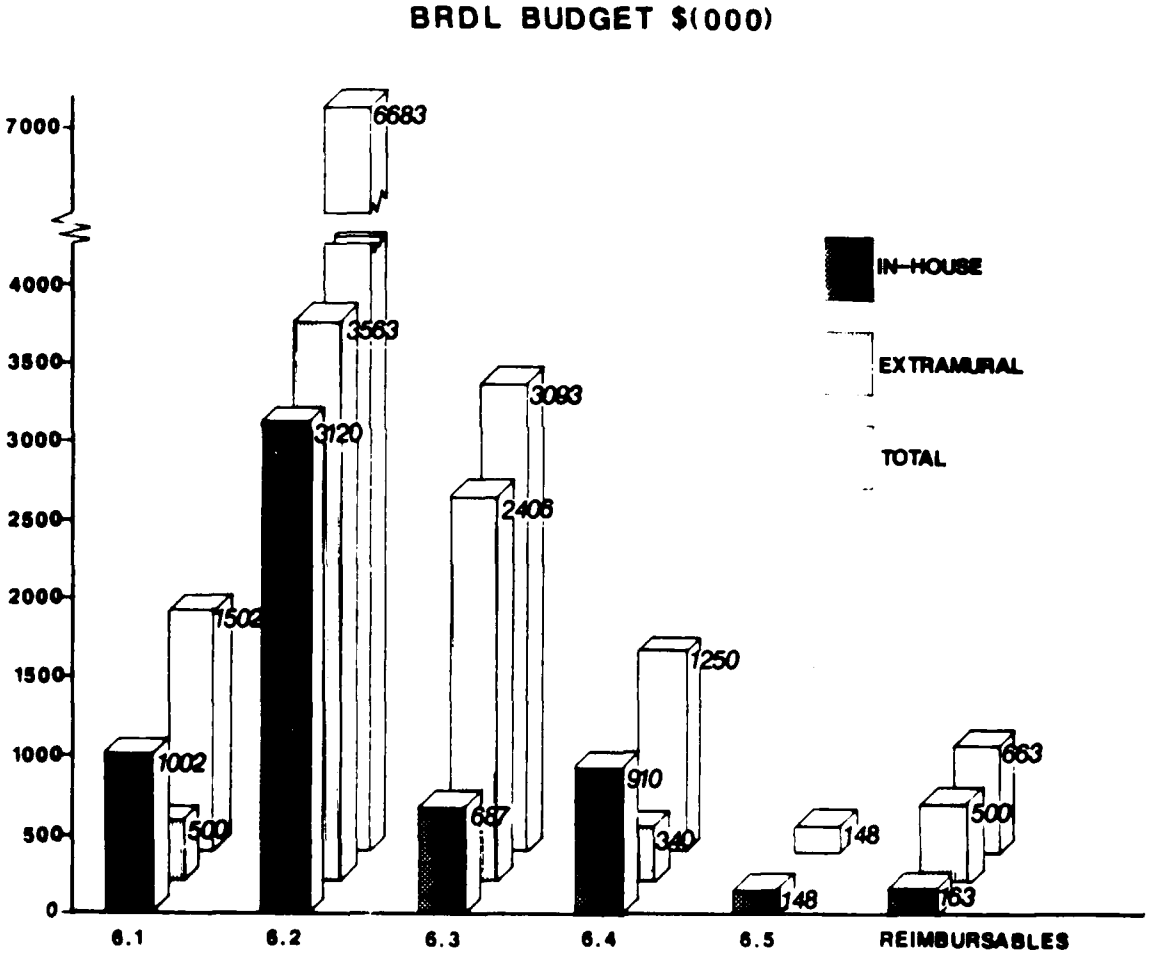
The FY86 in-house research and development budget for USAMBRDL totaled 6.030 million dollars, and the extramural program managed by the Laboratory totaled 7.310 dollars (table 2). Funds were derived from a diversified funding base reflective of significant program expansion and responsiveness to key Army readiness issues. The sources of this funding derive from a wide range of USAMRDC core program projects (Appendix I) supplemented by an equally wide range of reimbursable efforts (Appendix II).

TABLE 2. USAMBRDL FY86 OPERATING BUDGET

Funding Source and RDTE Project Category	Total FY86 Budget ($000)	
	Intramural	Extramural
1. US Army Medical R&D Command Core Program		
a. 6.1 Basic Research	1,002,000	500,000
b. 6.2 Exploratory Development	3,120,000	3,563,836
c. 6.3 Advanced Development	687,000	2,406,330
d. 6.4 Engineering Development	910,000	340,000
e. 6.5 Management Support	148,000	-0-
2. Reimbursable	163,000	500,000
TOTAL	6,030,000	7,310,166

In-House Dollar Resources:

The USAMBRDL's FY86 in-house budget of 6.030 million dollars by amount and funding source is presented graphically below. The basic research component of the budget includes funding received for In-House Laboratory Independent Research (ILIR) studies and consisted of 65 work units. In terms of budget execution, an obligation rate of 94 percent was achieved, with a target of 90 percent; a disbursement rate of 80 percent was achieved, with a target of 50 percent.



Extramural:

The USAMBRDL's FY86 extramural budget of 7,310 million dollars supports 54 work units. Funding sources are presented graphically in the figure above, and this budget comprises a particularly diversified funding base, both within the USAMRDC core funding program and from a list of reimbursable funding sources outside the USAMRDC. The USAMRDC core funding for environmental quality research derives from provisions of AR 200-1, "Environmental Protection and Enhancement," with major coordination of research programs with the U.S. Army Corps of Engineers.

Reimbursable funding resulted from major coordinated involvement between USAMBRDL and major elements of the U.S. Army munitions production and weapons developer communities. Growth in critical medical research support to Army readiness issues relating to the life cycle management of materiel and weapons systems is reflective of major policy clarification under AR 1000-1, "Basic Policies for System Acquisition;" AR 385-16, "System Safety Engineering and Management;" and AR 40-10, "Health Hazard Assessment Program in Support of the Army Materiel Acquisition Decision Process." USAMBRDL, in pursuing its mission of support to the field soldier, military workers, and public health, has worked closely with the materiel development and readiness community to integrate health and performance considerations in the development of new weapons systems and materiel. Medical research support to the U.S. Army Toxic and Hazardous Materiel Agency (USATHAMA) is in support of occupational health and environmental quality criteria development for unique military contaminant hazards associated with existing and new munition plant operations. Support to the Project Manager for Smoke and Obscurants focused on protecting military industrial workers during production and the field soldier during training and/or combat use of field munitions and weapons systems.

REVIEWS, SURVEYS, AUDITS, AND INSPECTIONS

During the year, the USAMBRDL successfully underwent several major inspections:

Department of the Army Inspector General:
- Travel Funds (commendation by inspection team)
- Antiterrorist Activities (review of process--highly satisfactory)

Headquarters, U.S. Army Medical Research and Development Command:
- Internal Review (a first "no findings" inspection)
- Logistics Assistance (highly satisfactory)
- Manpower Survey (absolute concurrence)

Fort Detrick:
- Physical Security (excellent rating)
- Information Security (excellent rating)
- Safety and Fire (excellent rating)

State of Maryland:
- Environmental Protection Agency Site Visit (satisfactory rating)

RESEARCH MANAGEMENT ENHANCEMENT

Research and Development Scope:

The direct objectives of the USAMBRDL research and development programs are on assurance of a physically and mentally fit military force for national defense. Casualty prevention is concerned with minimizing effects causing adverse performance to maximize Army readiness to support contingencies, mobilization, and combat operations. Translated into scenarios of operations, the USAMBRDL mission scope includes the field soldier's training and combat exposure setting, military industrial workplace exposures, and environmental quality exposures related to Army installation operations.

Within the mission support framework to the field soldier, military industrial workers, and environmental quality sectors, USAMBRDL research and development activities play multipurpose roles in both personnel health protection and in achieving Army combat readiness.

Medical Materiel Research and Development:

USAMBRDL plays the lead role in support of USAMRDC's responsibilities as the medical materiel developer for The Army Surgeon General. Mission functions in the technical base are directed toward the development of field medical equipment to support the diagnosis, treatment, and evacuation of combat casualties, and also equipment used in field preventive medicine environments. USAMBRDL activities are keyed in the five USAMRDC research areas:

Military Disease Hazards.

USAMBRDL focus is on development of vector control systems for prevention of military-important diseases. Intensified efforts concern the widespread involvement of U.S. soldiers in operations in tropical, arid, and other extreme environments with diverse vector-borne hazards.

Combat Casualty Care.

USAMBRDL focus is on development of treatment and evacuation equipment and on development of diagnostic and special purpose equipment for field applications.

Health Hazards of Military Systems and Combat Operations.

USAMBRDL focus is on development of techniques and procedures for hazard detection and provision of field water supplies for soldier and medical uses. Intensified efforts respond to Army rapid deployment force readiness concerns in relation to arid environments in which water consumption requirements are high and natural water supply qualities are poor.

Combat Maxillofacial Injury.

USAMBRDL focus is on development of equipment to enhance field dental care for combat maxillofacial injury and field dental emergencies.

Medical Aspects of Chemical Defense.

USAMBRDL focus is on development of equipment and techniques to facilitate medical treatment and evacuation in a chemical environment. This involves research in patient decontamination, development of specialized medical materiel, and chemical hardening of medical materiel.

Occupational Health Research Program:

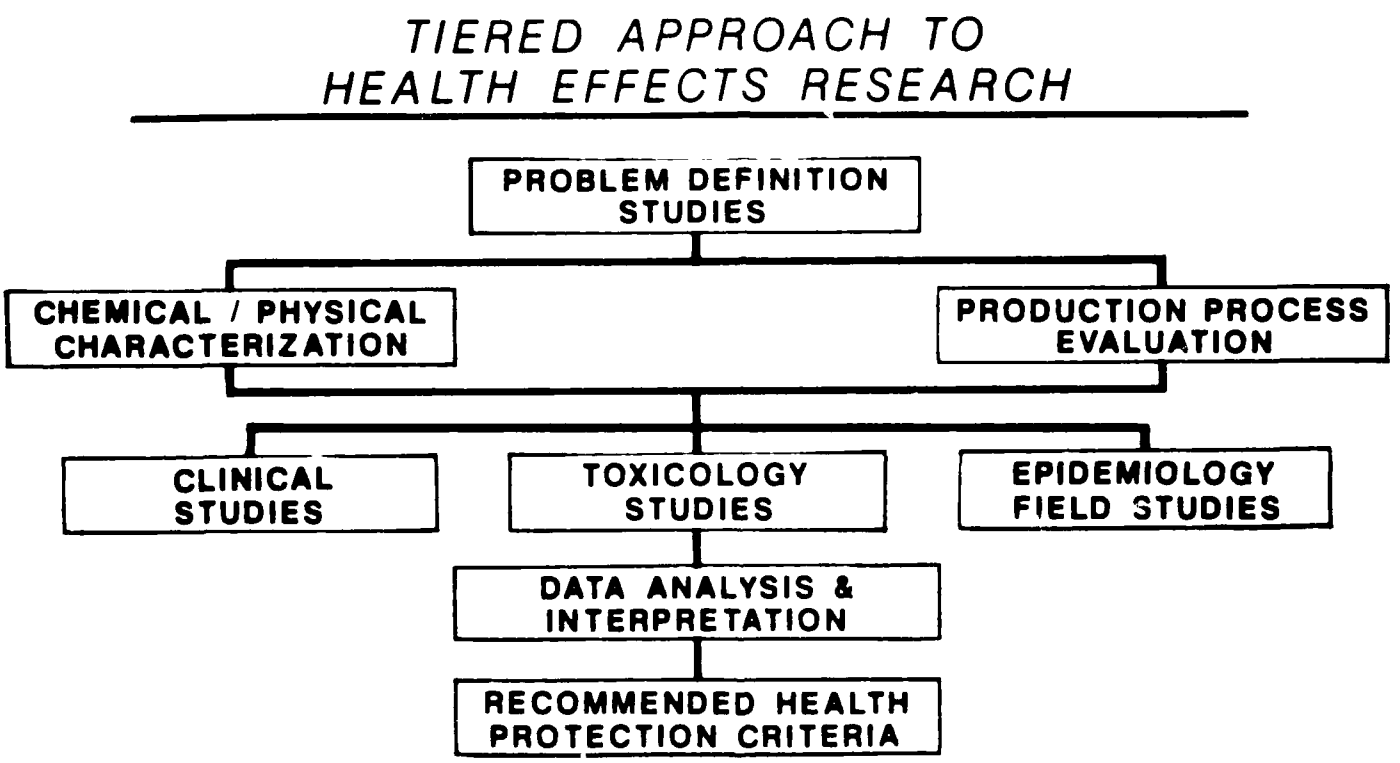
The USAMBRDL performs occupational health research to protect military personnel and civilian workers at Army activities from health hazards resulting from exposures to toxic chemical substances in the workplace and military personnel exposures to chemical, biological, and radiological contaminants associated with field water supply and sanitation. Specific program focus is on military-unique, highly relevant, and/or timely occupational health hazard issues resulting from the production, use, and disposal of Army weapon systems, military equipment and munitions, and from military-related field combat training operations. The research approach includes development of the scientific information data base necessary for health hazard evaluation and protection criteria recommendation, including: (a) chemical production, processing, use, and disposal evaluation to assess occupational exposures potentials; (b) chemical and physical characterization to support evaluation of exposure routes, toxic substance form, and concentration critical to biological effects evaluation; and (c) biological effects data base development through toxicologic testing, clinical, and epidemiologic studies to support evaluation of human effects.

Environmental Quality Research Program:

The environmental quality research program is focused on health and environmental effects research in the development of data bases to provide a hazard assessment of compounds unique to the Army and to evaluate the hazards presented by the disposal of military hazardous wastes. Directed compliance with environmental regulations such as the Clean Water Act (PL 95-217), Resource Conservation and Recovery Act (PL 94-580), and the Toxic Substances Control Act (PL 94-469), provides the basis for the environmental quality research program. To ensure that the research conducted in this program will be acceptable to the Federal regulatory agencies, continuous coordination is maintained with the U.S. Environmental Protection Agency. Health related data bases derived under this program are used to design pollution abatement systems for Army facilities and to provide target concentrations for military unique chemicals. The research approach parallels that of the occupational health research program but is modified to address unique issues of chemical transformation, transport and fate in the environment, and aquatic toxicological parameters of waterborne contaminants. Research continues to place emphasis on explosives and propellant production issues, and public health hazards from smokes and obscurants use; environmental quality hazards of conventional weapons demilitarization; and unique military issues associated with long-term hazardous chemical waste contamination.

Tiered Research Approach

Research activities within the occupational health and environmental quality research programs are sequenced to achieve development of the required scientific and biomedical data bases necessary to recommend health protection criteria. This sequencing design for USAMBRDL research has been critical to the linkage of medical research to major stages in the life cycle management of fielded and developmental materiel and weapons. This program approach has been fundamental for providing tailored medical input into issues on a timely basis and is relevant to engineering life cycle milestone stages in the Army's materiel acquisition process.



In-House Research Program Transition

Key expansion and change occurred during FY86 in the development of in-house laboratory methods and facilities during FY86. Basic research conducted through the in-house aquatic toxicology resources achieved significant productivity in developing short-term tests predictive of aquatic toxicologic endpoints. This effort is leading to a highly cost effective alternative approach to traditional methods of toxicology testing for compounds of military concern. Facility upgrades and renovations are being handled judiciously with a directed approach which is prudent and targeted to coincide with relocation of administrative staff.

Biomedical Data Base Development

USAMBRDL plays a leading role in medical research to acquire biomedical data used in recommending health protection criteria for Army personnel exposed to contaminant hazards in their workplace, and for recommending environmental quality protection criteria related to Army industrial operations and facilities. Research is focused on military-unique chemicals or exposure settings arising from field operations and fixed facility operations to include the development of health protection criteria for the soldier exposed to gun and rocket propellant combustion products, smokes and obscurants, and other field chemical hazards. Exposures may be typified by short, repeated, episodic, high concentrations often combined with other concomitant stresses.

USAMBRDL's research mission also involves the extensive base of U.S. Army industrial operations and fixed facility activities. Within the industrial workplace, such as the Army's tri-service munition production facilities, health protection standards are required for workers exposed to military unique chemicals and from unique process operations. U.S. Army industrial operations are governed by the same set of public health laws, augmented by Federal executive order, that apply to private industry. Medical research needs derive extensively from the presence of unique chemicals or processes not addressed under other health standards.

Health hazard assessment input to the Army Materiel Acquisition Program directly relates to biomedical data base development, and mission activities include research on techniques and procedures for contaminant hazard detection, identification, measurement, and exposure criteria development. Mission functions have their origin in AR 602-1 dealing with the "Army's Human Factors Engineering Program" reinforced by AR 40-10, "Health Hazard Assessment Program in Support of the Army Materiel Acquisition Decision Process;" AR 1000-1, "Basic Policies for System Acquisition;" AR 385-16, "System Safety Engineering and Management;" and AR 70-1, "Army Systems Acquisition Policy and Procedures."

Mission linkage to Army readiness is direct in the form of health protection standards for the soldier and is indirect through industrial workplace and environmental quality standards. In addition, biomedical data base development research activities not only support the standard setting functions for health and environmental quality protection but also result in a range of other decisions which contribute to Army readiness. These include weapons system design and use specifications, industrial hygiene program operations, workplace medical surveillance, use of engineering and personnel protective equipment, design and deployment of pollution abatement equipment, and decisions governing policies for casualty prevention.

Extramural Research Program Cooperative Expansion:

Interagency Cooperative Agreements

Major expansion occurred in the number of Federal laboratories through which interagency cooperative research was conducted. Major toxicological, clinical, and other laboratory research was initiated or continued at the national laboratories of the U.S. Department of Energy, the U.S. Environmental Protection Agency, the U.S. Food and Drug Administration, and the National Institutes of Health. These Federal laboratories are assets with a commonality of mission related interests. Conduct of USAMBRDL research through these laboratories involves cost savings and work performance using state-of-the-art methods and stable professional research staffs. Federal laboratory facilities are also a technically competent resource base for the surety requirements needed to conduct toxicologic studies for USAMBRDL's chemical weapons health effects research.

Intra-Army Cooperative Research

Formal arrangements were coordinated between USAMBRDL and the Letterman Army Institute of Research (LAIR), and toxicological testing studies were conducted on an interactive management basis. Studies involved conduct of the mutagenicity and acute mammalian toxicologic assays within the capabilities of the LAIR on selected munition process chemicals under comprehensive biomedical data base development by USAMBRDL staff. Cooperative research interactions also occurred between USAMBRDL, U.S. Army Medical Research Institute of Infectious Diseases, U.S. Army Medical Research Institute of Chemical Defense, and the U.S. Army Chemical Research, Development, and Engineering Center in relation to in-house research studies involving dilute and neat chemical agents and mycotoxins.

A Memorandum of Agreement with the U.S. Army Troop Support Command (TROSCOM) enhanced USAMBRDL's capabilities in fielding equipment in the broad area of preventive medicine. The designation of USAMBRDL as the Defense Construction Supply Center's primary laboratory for conducting first article testing of all items of equipment procured by this Center, under Federal Supply Code 3740, will accelerate the fielding of new equipment in this class. The selection of USAMBRDL to conduct first article testing will ensure that the field Army will receive the very best equipment obtainable. The USAMBRDL and the U.S. Army Medical Material Agency and the Academy of Health Sciences jointly evaluated field medical equipment (such as refrigerators) to maintain an avenue of mutual benefit to those agencies and the field soldier.

Defense Small Business Innovative Research (SBIR) Programs

During FY86 extramural research study efforts were continued and expanded in medical materiel, occupational health, field sanitation and water contract studies being conducted under the SBIR. Our support of this program provides the incentive to small businesses to produce major breakthroughs in technology while satisfying mandates of Congress.

CONTRIBUTIONS TO ARMY READINESS

Our concern for the soldier stems from the potential operational employment of U.S. Army troops in any area of the world to meet a wide spectrum of contingencies. To be prepared for deployment, personnel must undergo rigorous and realistic training. Therefore, the soldier will be exposed to not only the Army-unique hazards experienced in combat, but also those occupational hazards of the training environment. Our goal is to develop data through research which will provide relief for the soldier from the hazards inherent in military operations, worldwide.

In addition, the USAMBRDL fulfills The Surgeon General's research responsibilities in the protection of industrial workers and the surrounding community at Army-controlled, industry-operated munition plants. Our Environmental Quality Program provides that data base needed to enable the Army to establish standards for compliance with Executive Orders and the Clean Air and Water Acts as well as to develop pollution abatement procedures for Army munition plants and military installations.

Our Laboratory is also actively engaged in the development and ultimate fielding of field deployable military medical equipment and vector control systems, materials and equipment. These efforts are driven by the combat developer and are targeted to resolve recognized deficiencies described in the medical mission area analysis. To this end, medical materiel development in this Laboratory is managed under three discipline areas: Chemical Defense Materiel, Combat Casualty Care Materiel, and Military Disease Hazards.

Utilizing state-of-the-art technology to significantly upgrade the readiness posture while simultaneously lightening the force, the Field Medical Materiel Development Division has responded to Army Readiness issues in a highly productive manner as the following illustrate:

- The need for a Heater Unit, Patient Holding and Evacuation is well documented. In-house laboratory studies established the capability to evaluate supplemental heat sources and clearly demonstrated that the Norwegian charcoal heater system was capable of providing sufficient supplemental heat to maintain body temperature even at -50°F. Development of a carbon monoxide monitoring capability established that there were no safety hazards from carbon monoxide. Testing for potential thermal hazards indicated that protective insulation was necessary to prevent accidental minor skin burns. Modification of the assembly by USAMBRDL and user tests in Alaska confirmed the USAMBRDL laboratory test data. The complete Development Test reports and Operational Test reports are currently under review by the Office of The Surgeon General prior to preparation and publication of an "urgent operational requirement" and fielding of the assembly for Arctic operations. To optimize the system for Arctic casualty evacuation, tests were conducted to determine if the U.S. Army Arctic Evacuation Bag could be replaced by more effective bags. Testing of the Arctic Evacuation Bag and standard U.S. Arctic sleeping bags revealed that they were the best available. Tests included three commercial items, one U.S., two foreign evacuation bags, and the U.S. Army standard Arctic Evacuation and sleeping bags.

In-House Work Units

Liner, Heated, Patient Holding and Evacuation System; DAOA6282; Rhodes, C.T.

Battle Casualty Supplemental Heat Source; DA311254; Rhodes, C.T.

• The decision to go forward with a full-scale development contract on the Steam Vacuum Pulse and Ethylene Oxide Sterilization Systems will ensure state-of-the-art technology, thus improving the readiness posture of the U.S. Army Medical Department field hospitals in terms of time, throughput, and operational capabilities. The maximum daily throughput for the steam vacuum pulse sterilizer is 244 cubic feet of instruments and linens and 720 liters of solutions versus 128 cubic feet of instruments and 468 liters of solutions for the current field sterilizer (NSN 6530-00-926-2151). With high-vacuum equipment, the total sterilization time can be greatly reduced; once a vacuum has been drawn, steam permeates the load almost instantaneously. Currently, only the gravity sterilizer is available in the inventory.

In-House Work Units

Steam Vacuum Pulse Sterilizer (SVP) System; DAOG9318; Arnold, M.F.
Ethylene Oxide Sterilizer (EOS) System; DAOG9320; Arnold, M.F.

• In response to an expressed need by Special Operations Forces (SOF), a small, backpackable, multifueled sterilizer was designed and fabricated for their specific operational requirements. This sterilizer will enable SOF to have surgical sterilization capability under primitive field conditions.

In-House Work Unit

Ethylene Oxide Sterilization (EOS) System; DAOG9320; Arnold, M.F.

• A modification to the Surgical Scrub Sink (NSN 6545-01-117-3894) was proposed that eliminates a recurring problem of pump motor overheat and impeller failure. The modification was forwarded to the U.S. Army Medical Materiel Agency for action to correct the currently fielded surgical scrub sink. This modification will extend the service life of the scrub sink substantially.

In-House Work Unit

Technical Feasibility Testing of Medical Materiel; DA309494; Conway, W.H.

• As part of a continuing effort to capitalize on foreign medical developments, a field operating table and surgical light from the French Parachutist Surgical Unit assemblage were identified as addressing U.S. Army deficiencies. Actions are in progress to standardize the surgical light and there is strong interest in the operating table. These two items are being considered as direct replacements for comparable U.S. equipment which is obsolete.

In-House Work Units

Technical Feasibility Testing of Foreign Medical Materiel for Use in a Contaminated Environment; DAOG1894; George, D.T.

Technical Feasibility Testing of Medical Materiel; DA309494; Conway, W.H.

• To address the extremely important and real threat of chemical warfare agent (CWA) contamination of field medical materiel, the standard field litter was chosen as a model (due largely to its ubiquity, simplicity, and proximity to the casualty). An intensive investigation into alternative materials was begun and culminated in FY86 with the identification (following CWA testing) of polypropylene mesh materials and all-metal machined poles for production of a field litter which is chemical warfare agent resistant and which is capable of being thoroughly and rapidly decontaminated.

In-House Work Units

Chemical Hardening of Medical Field Chests; DAOG1513; Reams, W.H.

Chemical Hardening of Field Litters; DA306622; Reams, W.H.

• A major breakthrough has been accomplished by the development of the Pesticide Dispersal Unit, Multicapability, Helicopter Slung. The U.S. Army (USAMBRDL and TROSCOM) developed, but did not field, two separate helicopter-slung pesticide dispersal units (one for liquid and one for solid pesticide) to replace the fielded LIN U11083 (an internally mounted liquid pesticide dispersal unit). The two separate helicopter-slung pesticide dispersal units previously recommended for type classification in FY83 are being replaced by the Pesticide Dispersal Unit, Multicapability, Helicopter Slung, a single unit with liquid, ultra-low volume and solid pesticide dispersal capabilities. This Laboratory was informed 12 months ago that the multicapability unit could not be type classified using the requirement documents for the separate solid and liquid units. This fact jeopardized the funds targeted for procuring the much needed pesticide dispersal unit. The USAMBRDL, starting from the beginning working with the Academy of Health Sciences and the U.S. Army Troop Support Command compressed 4 years of work into 1 year. The requirements document is presently being staffed at the U.S. Army Training and Doctrine Command; the Technical Data Package (Drawing Package, Military Specification, Operations Manual) is complete and the Data Call is being prepared. The multicapability unit will now be procured using funds targeted for the other pesticide dispersal units and the first unit equipped date is 1988.

In-House Work Unit

Pesticide Dispersal Unit, Multicapability, Helicopter Slung; DA305615; Anderson, L.M.

• A new Army Collapsible Insect Surveillance (ACIS) Trap more commonly referred to as Mosquito Light Trap is 62 percent smaller and 33 percent lighter than the current trap in the Army inventory. The reduction of weight and cube were made without degrading trap efficiency. Durability was enhanced by using polyvinyl chloride (PVC) body and state-of-the-art electronics. The ACIS Trap, a lighter, more compact mosquito light trap will ensure the

maintenance of disease vector surveillance capability in preventive medicine teams and will be utilized to identify vector threats, malaria, and dengue hemorrhagic fever to troops in areas of known occurrences. This Laboratory cut years off the normal acquisition cycle by reengineering the 1932 model of the light trap and revising its military specification.

In-House Work Unit

Trap, Mosquito, Light, Collapsible; DA0G0701; Sardelis, M.R.

Contracts and Intragovernmental Transfers

Testing of the USAMBRDL Collapsible Light Trap in Panama; DA307558; U.S. Army Medical Department Activity, Panama (Lawson, M.A.); Boobar, L.R.

• Historically, louse-borne diseases have had a major impact upon the health, morale, and welfare of both military and civilian populations. Three important diseases of man transmitted by lice are relapsing fever, epidemic typhus, and trench fever. By using standard military and commercial components, the military-unique delousing outfit has been markedly improved. It is 47 percent lighter than the old unit and occupies 43 percent less space than the World War II era unit. It is capable of handling the same mission while being more versatile. The delousing unit is capable of being operated by itself, operated with a 2 1/2- or 5-ton military truck air supply, or operated on any military or commercial compressor. Newly designed nozzle assemblies are more accurate in delivery and more precise in metering output of pesticides. All of these factors combine to give the U.S. Army and the world a more efficient and practical means of human mass delousing. This Laboratory cut years off the normal acquisition cycle by reengineering the World War II era delousing unit and revising its military specification. A full-scale development pathway would have taken 6 to 8 years from beginning to fielding. The specification approach will save 4 to 6 years and allow an orderly phasing out of obsolete delousing units.

In-House Work Unit

Delousing Outfit; DA303165; Darby, W.H.

• To satisfy an immediate need for human blood shipment containers impermeable to CWA, material options were selected from an extensive data base. This data base permitted design, fabrication, and delivery of prototype containers to the blood research group at the Letterman Army Institute of Research for field testing during July 1986.

In-House Work Unit

Family of Medical Equipment Protective Containers; DA0B6248; Reams, W.H.

The Health Effects Research Division made important contributions to Army readiness by supporting the Army's Manpower & Personnel Integration (MANPRINT) program through the conduct of research and development to assess health hazards. Specific research and development results contributing to Army

readiness are:

- Development of a draft criterion document for the protection of soldiers in combat and in training from hydrogen chloride gas and particulates in the exhaust rockets using perchlorate-based solid fuels.

In-House Work Unit

Occupational Exposure Criteria Development; DA309066; Miller, T.A.

- Teratology studies on agents GB and GD concluded that female service members are not at reproductive risk in training with these agents, and that female workers are not at reproductive risk during chemical agent demilitarization operations.

Contracts and Intragovernmental Transfers

Teratology Studies on Agent GD; DA302231; USFDA National Center for Toxicological Research (LaBorde, J.B.); Dacre, J.C.

- Preventive medicine standards were developed for protecting soldiers from harmful chemicals in field water supplies. Also, two candidate disinfectants were identified as replacements or adjuncts to the existing field water disinfectants--chlorine and iodine.

In-House Work Unit

Occupational Exposure Criteria Development; DA309066; Miller, T.A.

Contracts and Intragovernmental Transfers

New Disinfection Agents for Water; DA300021; Auburn University (Worley, S.D.); Eaton, J.C.

Evaluation of Field Water Data Base Assessment Study Deliverables; DA304816; USDOE Oak Ridge National Laboratory (Ross, R.H.); Schaub, S.A.

Data Base Assessment of Environmental and Toxicological Factors in Water to Upgrade and Modernize Content of TB Med 577; DA300881; USDOE Lawrence Livermore National Laboratory (Anspaugh, L.R.); Schaub, S.A.

- Actions to improve the responsiveness and environmental compliance of Army Ammunition Plants included the development of water quality criteria for three munitions chemicals--nitrocellulose, nitroglycerin, and RDX.

In-House Work Unit

Identification and Health Effect of Military Pollutants; DA309063, Miller, T.A.

- Protection of Army production base assets was realized through the development of clean-up objectives for Cornhusker Army Ammunition Plant. Also, guidelines were established for determining a criterion for the occurrence of DIMP (diisopropyl methylphosphonate) in groundwater at Rocky Mountain Arsenal.

In-House Work Unit

Identification and Health Effects of Military Pollutants; [illegible]4309063; Miller, T.A.

MATERIEL FIELDED/TYPE CLASSIFIED/STANDARDIZED

• A commercial plastic roll-up extraction litter (Skedco litter), originally identified by this laboratory, was tested and is being standardized. Request for a national stock number (NSN) has been made. The Basis of issue is one per air ambulance set, and it will be offered as a Common Table of Allowances (CTA 8-100) item.

• The Case Surgical Instrument and Supply Set (Medical Aidman's Bag) developed by this Laboratory, became available for fielding with the production of 5000 units. The new bag is a great improvement over the current medical aid bag. The new bag is compartmentalized and allows rapid display, identification, and selection of individualized medical items for emergency treatment under hostile field conditions. Attendance of multiple casualties necessitates repeated use of medical items; the compartmented medical aid bag again provides rapid access to all items displayed in an organized fashion. Searching through a large, single compartment medical aid bag for a lifesaving item in the dark, under fire, is difficult. Immediate access capability provided by the new compartmented aid bag will result in improved survivability for the injured soldier and the entire team which is required to treat the injured team members as expeditiously as possible. The new aid bag which can be carried in several ways also affords protection of contents against chemical warfare agents.

• The aerosol generator, which was typed classified and transitioned to the Readiness Command in 1983, was lagging behind its scheduled procurement date. As the Quality Assurance Advisor to TROSCOM, USAMBRDL was instrumental in expediting procurement, and USAMBRDL completed first article testing this fiscal year.

• As Quality Assurance Advisor and Specification Manager of Backpack Dusters, USAMBRDL maintains awareness of ongoing procurement actions. Fielding of the backpack was on schedule; however, the request for bids cited the wrong specification. This Laboratory took immediate action to get the contract canceled and a new request for bid was submitted by the Defense Construction Supply Center. The first article test has been completed. Early detection of this error not only saved the government money, but saved a year in fielding time.

• This Laboratory has modified fielded pest control equipment to be used as decontamination equipment. The Kioritz backpack sprayer, using a 3-horsepower engine, and the Hudson 2-gallon compression sprayer were chosen for modification and testing as decontamination sprayers. These units are lightweight, easily transportable by one person and are already fielded. The Hudson 2-gallon sprayer has additional advantages: it does not require gasoline or electricity and it is already in the Field Sanitation Teams (one per line company) as required by AR 40-5. One sprayer is recommended per team by Training Circular 8-3 and authorized by Common Table of Allowances 50-909. Comparative evaluation of sprayers and nozzles using charcoal simulant has been completed. The results of these tests indicated both the Hudson 2-gallon

sprayer and the Kloritz backpack sprayer would be effective in toxin removal from skin. Field issue liquid detergent was the most efficacious soap tested, and the 65^{O} angle fan nozzle provided the most efficient shape for the spray. The modification will enhance Army readiness by providing a nuclear, biological, chemical (NBC) decontamination capability to line Commanders.

PATENTS

Patents have been submitted on three new inventions:

- The statometric technique of determining blood pressure and heart rate.

- An Army Insecticide Measuring System (AIMS) aspirator was developed to improve the efficiency of the AIMS. The aspirator places a velocity on the droplets thus allowing the AIMS to be used at the droplets point of impact.

- A rabbit restrainer was developed to secure a rabbit on top of an insect cage for insect feeding. The restrainer can also be used on a lab bench to perform procedures such as injections, toxicity studies, and health care treatments.

Patents are in preparation on two new inventions:

- A new mosquito light trap has been developed to improve readiness. The trap has many uses in the civilian community.

- A human mass delousing unit was developed to replace the World War II model. The manifold from this unit allows the use of many different air supplies.

It should be noted that the number of patent applications is 400 percent higher than the previous 4 years combined.

OTHER MAJOR RESEARCH AND DEVELOPMENT ACCOMPLISHMENTS

During FY86, the Health Effects Research Division's research and development program was accomplished through 21 in-house work units and 42 extramural efforts. Principal research accomplishments are detailed below:

• In-House Environmental Fate and Effects Research was conducted to determine the microbial fate of two munitions compounds, nitroguanidine and dinitrotoluene (2,4 and 2,6 isomers). The mineralization of carbon-14 guanidinium has been demonstrated in three different Maryland soils. Results indicate that the cation can be extensively biodegraded at low concentrations by soil microflora. Similar results were not obtained in poisoned (mercuric chloride and/or sodium azide) or autoclaved soils. Microbial populations in soil could not be saturated at guanidinium levels up to 400 milligrams/liter. A method for extracting guanidinium from soil has been developed, and approximately 90 percent of the guanidinium added to soil samples can be recovered. Using the method, it has been determined that except for microbial action, guanidinium is stable in soil: residual carbon-14 label remaining after microbial action can be recovered only as guanidinium. The addition of metabolizable carbon to soil samples has been shown to enhance mineralization of guanidinium by microorganisms, whereas the addition of nitrogenous compounds also found in nitroguanidine waste streams shows only slight inhibition. Incubation of radiolabeled 2,4- and 2,6-dinitrotoluene isomers in water samples from the New River at Radford Army Ammunition Plant has resulted in biodegradation of the compounds. The 2,4-isomer has been consistently biodegraded much more rapidly than the 2,6-isomer.

In-House Work Unit
Identification and Health Effects of Military Pollutants; DA309063; Miller, T.A.

• In-House Experimental Toxicology Research is a new start, involving the establishment of research facilities and programs for evaluating alternative animal models for toxicity testing on Army-unique munitions chemicals. Protocols have been prepared under a memorandum of agreement for metabolism studies in the animal room facilities at the U.S. Army Medical Research Institute of Infectious Disease. A literature review is being completed on potential short-term nonmammalian tests systems for the detection of chemical teratogens. Procurement of laboratory equipment and supplies is in progress. Setup of Medaka fish embryo assay for chemical teratogens has been initiated.

In-House Work Unit
Basic Research in Experimental Toxicology; DA309065; Miller, T.A.

• In-House Aquatic Toxicology Research has provided data which suggest that exposure and holding temperatures above 25°C do not increase either the number or rate of development of tumors induced in fish by a known carcinogen. A paper on these findings was presented at the Society of Environmental Toxicology and Chemistry (SETAC) meetings in early FY86. A poster was also presented at these meetings on the acute and chronic toxicity of 1,3,5-

trinitrobenzene (TNB), 3,5-dinitroaniline, and their mixtures to an aquatic invertebrate. A paper on the effects of 1,3,5-trinitrobenzene (TNB) on the ventilatory patterns of bluegills was presented at the tenth American Society for Testing and Materials (ASTM) aquatic toxicology symposium in May 1986, and a manuscript has been submitted for publication in the peer-reviewed symposium proceedings. Two visiting university faculty members, serving under an Army Research Office program, completed summer research on light and electron microscope characterization of neoplasms in fish. A definitive test to determine the effects of three temperatures (20, 25, and 30°C) on the carcinogenic effects of three chemicals was completed. Data have been compiled and statistically analyzed for several years of testing with an automated system for monitoring toxicant effects on the ventilatory patterns of fish. A biomonitoring trailer, using a computerized fish ventilatory monitoring system, has been established on site at the Fort Detrick wastewater treatment plant. Daphnia pulex was selected as the best species for use in a test protocol for determining the effects of water quality parameters on toxicity. Three papers were accepted for presentation at the SETAC meetings in November 1986: the evaluation of a pharmacokinetic model for predicting the effects of time-varying concentrations of TNB on daphnids; environmental effects of chemical mixtures; and a paper to be presented as part of a workshop on biological monitoring techniques.

In-House Work Unit
Basic Research in Aquatic Toxicology; DA309062; Miller, T.A.

• In-House Environmental Engineering Research supported field studies of wastewater treatment by semicontinuous activated sludge at Holston Army Ammunition Plant have been completed. Evaluation of individual unit processes for wastewater treatment at Holston Army Ammunition Plant is in progress. A manuscript describing treatability studies at Sunflower Army Ammunition Plant, "Munitions Production Wastewater I. Treatment for Removal of Nitroguanidine and Guanidine by Carbon Adsorption and Ion Exchange," is under revision for publication in Water Research; and technical reports concerning ultraviolet radiation and rotating biological contractor studies at Holston Army Ammunition Plant are in review. Development of a bench-scale, filter-leaf procedure for testing various reverse osmosis membranes for removal of chemical agent surrogates has been found to be impractical. A report of findings has been submitted.

In-House Work Unit
Identification and Health Effects of Military Pollutants; DA309063; Miller, T.A.

• Occupational Health Chemistry Research was conducted to determine qualitatively and quantitatively the occupational exposures of personnel firing Army rockets and guns. A near-real-time atmospheric HCl monitor has been developed that responds to HCl from rocket exhaust, such as the Multiple-Launch Rocket System (MLRS). A solid phase extraction technique has been demonstrated to concentrate the chemical agents GA, GB, GD, and VX from below 5 micrograms/liter to a level where they can be detected with the M-272 enzyme

test tickets. The stability of agents on the solid phase extraction columns for 7-day GD, GB, and VX has been completed. A report entitled "The Use of Solid Phase Extraction Systems to Improve the Sensitivity of Artemia Bioassays for Mycotoxins" has been submitted for publication. A gun tube for collecting the combustion products from small calibre weapons has been partially assembled and a bullet catcher continues in design. This system will be used to study combustion products from standard ammunition used in the M-16 rifle and the M-60 machine gun.

In-House Work Unit

Occupational Exposure Criteria Development; DA309066; Miller, T.A.

• In-House Analytical Chemistry produced a study on "Specific Pollutant Adsorbent Polymers" which was presented at the American Chemical Society in April 1986. The preparation and evaluation of organic polymers by ionic initiation are continuing. For silica gel adsorbents, the power of adsorption of the modified gels was found to be unaffected by molar concentrations of TNT and HMX. The study on RDX is scheduled to continue after receipt of samples from Holston Army Ammunition Plant. A comprehensive paper is being prepared on "Specific Polymer Adsorbents." A paper on hypochlorite treatment of verrucarol was published in the Journal of Organic Chemistry in May 1986, and a second paper on the secondary transformation products from verrucarol is scheduled for publication in the same journal in December 1986. The research is scheduled for presentation at ACS Middle Atlantic Regional meeting in September 1986. A technical report on the analysis of TNB by gas chromatography and high performance liquid chromatography has been published. A technical report on the analysis of N,N'-bis(2,4,6-trichlorophenyl)urea is in preparation. The development of the analytical methods for the carcinogens (methylazoxy)-methanolacetate (MAM), and 1-methyl,3-nitro,1-nitrosoguanidine in water has been completed, and a technical report is in preparation. These methods have been critical to the continuing research conducted in-house by this Laboratory to find alternative animal models for toxicity testing. Technical reports on the occurrence of polynuclear aromatic hydrocarbons (PAHs) in deactivation furnace ash from experimental demilitarization of conventional munitions at Toelle Army Depot have been completed, and a comprehensive health hazard assessment report is in preparation. Work was completed for the U.S. Army Electronics Command demonstrating that the Army's new-generation lithium thionyl chloride batteries can be safely disposed of in sanitary landfills.

In-House Work Units

Novel Synthetic Polymers for Sorption and Removal of Hazardous Pollutants from Wastewater at Military Installations; DA309061; Kulkarni, R.K.

Identification and Health Effects of Military Pollutants; DA309063; Miller, T.A.

• Smoke and Obscurants Research has continued to develop a health hazard data base for smoke and obscurant munitions to enable development of health protection guidelines and exposure criteria for military personnel in the field and support personnel in the industrial workplace; provide information

for health hazard assessments. Final reports on the inhalation toxicities of red phosphorus/butyl rubber, yellow dye and green/yellow mixture, and fog oil are in preparation for transmittal to the Project Manager for Smoke and Obscurants. The draft final report on the acute toxicities of red and violet dye mixtures was reviewed and approved. The subchronic inhalation toxicity study of the fill in the M76 grenade is in progress. The Phase I report was reviewed and returned for revisions. The Phase II report is in preparation.

In-House Work Units

Occupational Exposure Criteria Development; DA309066; Miller, T.A.

Identification and Health Effects of Military Pollutants; DA309063; Miller, T.A.

Contracts and Intragovernmental Transfers

Smoke and Obscurants: A Health and Environmental Effects Data Base Assessment; DA302759; USDOE Lawrence Livermore National Laboratory (Shinn, J.H.); Rosenblatt, D.H.

Field Measurement and Model Evaluation Program for Assessment of the Environmental Effects of Military Smokes; DA304000; USDOE Argonne National Laboratory (Policastro, A.J.); Parmer, D.L.

Evaluate and Characterize Mechanisms Controlling Transport, Fate, and Effects of Army Smokes in the Aerosol Wind Tunnel; DA304087; USDOE Pacific Northwest Laboratory (Van Voris, P.); Barkley, J.J.

Environmental Fate and Effect Studies on Multispectral Smoke; DA307960; US Army Chemical Research, Development, and Engineering Center (Wentsel, R.S.); Barkley, J.J.

Continuation of Field Ecological Assessment Procedures to Evaluate the Environmental Effects of Using Large Area Training Smokes; DA306104; US Army Construction Research Laboratory (Novak, E.); Parmer, D.L.

Dermal, Eye and Oral Toxicologic Evaluations; DA300090; Bioassay Systems Corporation (Mayhew, D.); Reddy, G.

Behavioral-Physiological Effects of Red Phosphorus Smoke Inhalation on Two Wildlife Species; DA307238; USDA Denver Wildlife Research Center (Thompson, R.D.); Gardner, H.S.

Toxicity of DEGDN, Synthetic-HC Smoke Combustion Products, Solvent Yellow 33 and Solvent Green 3 to Freshwater Aquatic Organisms; DA307134; Naval Sea Systems Command, Johns Hopkins Applied Research Laboratory (Burton, D.T.); Kelly, J.A.

Water Quality Criteria for Colored Smokes; DA309543; USDOE Oak Ridge National Laboratory (Ross, R.H.); Rosencrance, A.B.

Chemical Characterization and Toxicologic Evaluation of Airborne Mixtures; DAOG5136; USDOE Oak Ridge National Laboratory (Guerin, M.R.); Eaton, J.C.

Environmental Effect Studies on EA5763; DA306599; US Army Chemical Research, Development, and Engineering Center (Wentsel, R.S.); Gardner, H.S.

Research and Development on Inhalation Toxicologic Evaluation of Red Phosphorus/Butyl Rubber Combustion Products; DAOH0386; Illinois Institute of Technology Research Institute (Aranyi, C.); Finch, R. A.

Inhalation Toxicology of Fog Oil Obscurant; DAOG7492; USEPA Health Effects Research Laboratory (Grose, E.); Finch, R.A.

• Environmental Basic Research studies have continued to develop predictive models of adverse effects on humans and the environment from exposures to contaminants, to determine toxic hazards created by military-unique chemicals, and to develop predictive techniques for evaluating health and environmental hazards associated with military-unique exposures. Grant proposals were recently reviewed at the National Cancer Institute under a fish carcinogenicity project that is jointly funded by Department of the Army, the National Institute for Environmental Health Sciences, and the National Cancer Institute. There were 56 respondents to the request for proposals, and the reviewers found the overall quality to be excellent. Approximately eight of the proposals will be funded. A final report was received from the U.S. Environmental Protection Agency Laboratory at Gulf Breeze, MS. This work involved characterization of lesions in two species of fish exposed to diethylnitrosamine (DEN), a known carcinogen. Development of neoplasms were noted, and an exzyme-altered focus was found to be useful as a possible marker for future studies on early neoplasm development.

In-House Work Unit

Basic Research in Environmental Toxicology; DA309062; Miller, T.A.

Contracts and Intragovernmental Transfers

Histological, Histochemical, and Ultrastructural Characterization of Lesions in Fishes Exposed to Known Carcinogens with Emphasis on Neoplastic Development; DA302452; USEPA Environmental Research Laboratory, Subine Island (Couch, J.A.); Kelly, J.A.

Collaborative Research Program: Interlaboratory Testing of Aquatic Microcosm Protocol; DA302965; US Food and Drug Administration (Hoffman, B.L.); van der Schalie, W.H.

Reproductive Evaluation of Potential Toxicants; DA305366; USEPA Health Effects Research Laboratory (Laskey, J.W.); Henry, M.C.

Biochemical, Pharmacological, and Tumorigenic Effects of Drinking Water Carcinogens on Fish; DA301798; National Cancer Institute (Cameron, T.R.); Kelly, J.A.

• Occupational Basic Research continues to develop predictive models of adverse effects on humans from exposure to contaminants, to determine toxic hazards created by military-unique chemicals in the occupational workplace, and to develop predictive techniques for health hazards associated with military-unique exposures. A respiratory tract deposition model is refining techniques for measuring toxic effects equally well in both *in vitro* and *in vivo* samples. The sensitivity of antioxidant techniques was increased so they could be applied to the *in vitro* systems. The hybrid mouse model project completed a preliminary transplacental bioassay system. Treatment with ethylnitrosourea (ENU) and phenobarbital showed a higher number of liver foci than treatment with ENU alone. The liver DNA adducts were higher than in lung, but the lung adducts were more persistent.

In-House Work Unit

Basic Research in Experimental Toxicology; DA309065; Miller, T.A.

Contracts and Intragovernmental Transfers

Extrapolation of Inhaled Particulate Toxicity Data from Experimental Animals to Humans; DA305393; USEPA Health Effects Research Laboratory (Hatch, G.E.); Henry, M.C.

Development of a Mouse Lung-Liver Model for the Testing of Military-Relevant Compounds for Carcinogenic Activity; DA306631; Medical College of Ohio (Stoner, G.D.); Henry, M.C.

• Conventional Weapons Research is developing a biomedical data base for soldier and civilian worker exposure to chemical hazards associated with conventional weapons systems and to recommend criteria, guidelines and corrective measures for exposures to identified chemical hazards. Planning for the field trial on neurobehavioral responses to carbon monoxide is continuing. Coordination with other relevant programs continues to be made to determine if joint efforts in the development of physiological instrumentation are feasible. Recommendations by The Army Surgeon General for research priorities to support the health hazard assessment process have been received and research plans are being prepared. Proposals for the field evaluation of armored vehicle combustion products, a study on the chemical characteristics of emissions from varying gun propellant types and charge sizes, and evaluation of soldier demographic data are being planned.

In-House Work Unit

Occupational Exposure Criteria Development; DA309066; Miller, T.A.

Contracts and Intragovernmental Transfers

Human Health Studies of Carbon Monoxide (CO) Under Conditions of Military Weapons System Crewman Exposures; DAOG7486; USEPA Health Effects Research Laboratory (Benignus, V.A.); Parmer, D.L.

Neurobehavioral Effects of Carbon Monoxide (CO) Exposure in Humans; DAOG7494; USEPA Health Effects Research Laboratory (Benignus, V.A.); Kelly, J.A.

Lead Exposures and Biological Responses in Military Weapons Systems, (ANL P-8612C); DA310641; USDOE Argonne National Laboratory (Bhattacharyya, M.H.); Parmer, D.L.

Mortality of Munitions Workers Exposed to Dinitrotoluene; DAOG3440; Chemical Industry Institute of Toxicology (Levine, R.J.); Parmer, D.L.

Evaluation of DEGDN (Diethyleneglycoldinitrate) and Two DEGDN Containing Compounds; DA305429; USDOE Laboratory for Energy-Related Health Research (Goldman, M.); Parmer, D.L.

Health Effects Research on Dimethylsulfoxide (DMSO) Munition Recrystallization Process Solvent. Phase II.; USDOE Laboratory for Energy-Related Health Research (Goldman, M.); Dacre, J.C.

Problem Definition Study for Evaluating the Chemical and Toxicological Properties of the Combustion Products of Rifle and Gun Systems; DA307122; USDOE Oak Ridge National Laboratory (Ross, R.H.); Parmer, D.L.

Combustion Product Evaluation of Various Charge Sizes and Propellant Formulations; New Start ; Illinois Institute of Technology Research Institute (Snelson, A.);Hoke, S.M.

Evaluation of Weapons' Combustion Products in Armored Vehicles, Arthur D. Little, Inc. (Menzies, K.T.); Young, J.Y.

• Chemical Weapons Research focuses on toxicological research and occupational health test development continue on specific health hazard issues involved in the handling, maintenance, and demilitarization of chemical weapons. The work on all the studies is progressing on schedule; teratology in rats and rabbits, negative at dose levels of 0.25, 1.0, 4.0 micrograms/kilogram BW on days 6 through 15 of gestation (rats) and on days 6 through 19 (rabbits). Final reports on teratology studies in rats and rabbits with GB (Types I and II) and GD have been received. Teratology on mustard (HD) has been completed and will be followed by the final definitive studies on lewisite (L). Other toxicology studies on agents GB, GD, HD, and L are in progress. Preparation of criteria documents for agents has been initiated. Adequate sensitivity has been achieved in chemical tests for BZ and two major metabolites in buffered solutions and urine for BZ. Several monomeric diacetylene compounds have been prepared and taken to Dugway Proving Ground to be tested as dosimeter indicator compounds for G and V agents.

In-House Work Unit

Biomedical Assessment of the Toxic Effects of Chemical Agents; DA309067; Miller, T.A.

Contracts and Intragovernmental Transfers

Development of a Confirmatory Chemical Test for Exposure to 3-Quinuclidinyl Benzilate (BZ); DA308749; National Bureau of Standards (White, E.); Bausum, H.T.

Teratology Studies on Agent GD; DA302231; USFDA National Center for Toxicological Research (LaBorde, J.B.); Dacre, J.C.

Teratology Studies in Lewisite and Sulfur Mustard Agents; DA302726; USDOE Pacific Northwest Laboratory (Sasser, L.), Finch, R.A.

Toxicity Studies on Agent VX; DA300087; USDOE Laboratory for Energy-Related Health Research (Goldman, M.); Dacre, J.C.

Toxicity Studies on Agents GB and GD; DA305392; USDOE Laboratory for Energy-Related Health Research (Goldman, M.); Dacre, J.C.

Chemistry and Toxicology of Water Treated with Hypochlorite to Detoxify Chemical Agent VX; DA305445; USDOE Pacific Northwest Laboratory (Kalkwarf, D.R.); Rosenblatt, D.H.

Toxicity Studies on Lewisite and Sulfur Mustard Agents; DA305394; USDOE Pacific Northwest Laboratory (Sasser, L.); Dacre, J.C.

Occupational Criteria Documents for Chemical Agents; DA311206; USDOE Oak Ridge National Laboratory (Ross, R.H.); Dacre, J.C.

• Field Water Research is concerned with preventive medicine efforts to enhance the operational capability of the soldier (in combat and training) through elimination of exposures to high risks of disease, illness, or injury by establishment of appropriate health criteria, risk assessment, monitoring technology, and improved protection capabilities for field water supplies and waste disposal. Draft water quality standards for lindane and risk assessment of nonconsumptive microbiological parameters have been prepared and have undergone review and comment by Oak Ridge National Laboratory. Round robin tests, sponsored by the American Society for Testing and Materials, to evaluate methods to detect virus in soils are now in progress, with three soil

types under test at nine laboratories. Kinetic disinfection studies on hepatitis A and three other enteric viruses were initiated using calcium hypochlorite and iodine field water disinfectants. Disinfection studies using an N-chloramine compound containing both bromine and chlorine are being performed on a series of test microorganisms.

In-House Work Unit

Occupational Exposure Criteria Development; DA309066; Miller, T.A.

Contracts and Intragovernmental Transfers

New Disinfection Agents for Water; DA300021; Auburn University (Worley, S.D.); Eaton, J.C.

Evaluation of Field Water Data Base Assessment Study Deliverables; DA304816; USDOE Oak Ridge National Laboratory (Ross, R.H.); Schaub, S.A.

Effect of Chloride on the Virucidal Effectiveness of Chlorine Disinfectants for Military Needs; New Start; University of Cincinnati (Berg, G.); Schaub, S.A.

Data Base Assessment of Environmental and Toxicological Factors in Water to Upgrade and Modernize Content of TB Med 577; DA300881; USDOE Lawrence Livermore National Laboratory (Anspaugh, L.R.); Schaub, S.A.

Rapid Bioassay Monitoring System for Water Quality - Phase 2, Tasks 2-12; DA303278; Wyatt Technology Corporation (Wyatt, P.J.); Schaub, S.A.

Inactivation of Hepatitis A Virus (HAV) by Chlorine and Iodine in Water; DA308753; University of North Carolina (Sobsey, M.D.); Schaub, S.A.

- Fuels and Lubricants Research continued to assess the health hazard potential of military fuels (including their vapors and combustion products) and lubricants to include those whose sources are other than conventional or whose uses are innovative and unique. Tumorigenicity assays of five different samples of diesel fuels from both petroleum and alternate sources (tarsands and shale) are under way. Plans have been completed to conduct a coordinated air-sampling study at Fort Carson, CO, involving the U.S. Army Forces Command and the 4th Infantry Division. The purpose of this study is to determine the composition and concentration of diesel-fuel related materials to which troops and civilian workers are exposed in the military motorpool environment.

In-House Work Unit

Occupational Exposure Criteria Development; DA309066; Miller, T.A.

Contracts and Intragovernmental Transfers

Field Sampling and Analysis of Shale Oil Derived Airborne Diesel Exhausts; DA306952; USDOE Oak Ridge National Laboratory (Guerin, M.R.); Eaton, J.C.

Army Synthetic and Alternative Fuels Health Hazard Characterization; DAOH0036; USDOE Oak Ridge National Laboratory (Guerin, M.R.); Eaton, J.C.

- Environmental Quality Research develops the scientific data base defining the environmental and health effects associated with the past and current production, use, and disposal of Army relevant chemicals generated in industrial and field training operations. The data base is designed to be sufficient to protect the environment and human health. The purpose of the

research is to avoid or mitigate significant environmental degradation, maintain readiness, provide rational and economic goals for treatment plant design, and provide a basis for defense in litigations and the establishment of discharge permits. Environmental fate and effects studies on phosphorus and infrared screening smokes have been completed. Environmental criteria documents have been prepared for nitrocellulose (NC), RDX, and TNG.

In-House Work Unit

Identification and Health Effects of Military Pollutants; DA309063; Miller, T.A.

Contracts and Intragovernmental Transfers

Neurotoxicology of Cyclotrimethylenetrinitramine (RDX); DA300033; USEPA Health Effects Research Laboratory (MacPhail, R.); Reddy, G.

Conventional Weapons Demilitarization: A Health and Environmental Effects Data Base Assessment; DA302760; USDOE Lawrence Livermore National Laboratory (Layton, D.); Rosenblatt, D.H.

Field Validation of an Aquatic Microcosm Toxicity Test; DA310902; US Environmental Protection Agency (Plafkin, J.); Gardner, H.S.

Plant Uptake of 2,4,6-Trinitrotoluene (TNT), A Model for Polar Organic Compounds; DA301895; US Army Waterways Experiment Station (Folsom, B.L.); Bausum, H.T.

Army Environmental Quality Technology Program Coordination; DA303762; US Army Construction Engineering Research Laboratory (Novak, E.W.); Barkley, J.J.

A Health and Environmental Effects Data Base Assessment of US Army Waste Material; DA303914; Caritech Associates, Inc. (Uhrmacher, J.C.); Small, M.J.

Environmental Fate of Nitroguanidine, Diethyleneglycol Dinitrate, and Hexachloroethane Smoke; DA305052; SRI International (Spanggord, R.J.); Small, M.J.

The Fate of Selected Organic Pollutants During Landfill Disposal Operations; DA306060; Georgia Tech Research Institute (Pohland, F.G.); Burrows, W.D.

Development of a Theoretical Model to Assess the Hepatocarcinogenic Potential of Chemicals Using Structure-Activity Relationships and the Rat Hepatocyte Assay; DA306401; SRI International (Spanggord, R.J.); Rosenblatt, D.H.

Health Advisories on Munition Chemicals; DA307948; US Environmental Protection Agency (Khanna, K.); Bausum, H.T.

Methods for Estimating Physiochemical Properties of Inorganic Chemicals of Environmental Concern; DA302715; Arthur D. Little Inc. (Lyman, W.J.); Rosenblatt, D.H.

Fish Pathology Workshop; DA308762; National Cancer Institute (Cameron, T.P.); Gardner, H.S.

Support for Grant Entitled "Development of Software for Genetic Toxicology Data Management"; DA309009; USEPA Environmental Monitoring Systems Laboratory-Las Vegas (Williams, L.R.); Barkley, J.J.

Estimation of Melting Point; DA306024; University of Arizona (Yalkowsky, S.H.); Rosenblatt, D.H.

Determination of the Chronic Mammalian Toxicological Effects of RDX; DAOG0961; Illinois Institute of Technology Research Institute (Lish, P.M.); Barkley, J.J.

Workshop on Alternative Approaches to Toxicity Testing; DA311346; National Institute of Environmental Health Sciences (Gardner, E.); Gardner, H.S.

Toxic Chemicals and Aquatic Life: Research and Management; DA309010; Northwest and Alaska Fisheries Center (Malins, D.C.); Henry, M.C.

Studies on the Etiology of Neoplasia in Poikilothermic, Aquatic Animals: Finfish and Shellfish; DA311213; National Cancer Institute (Longfellow, D.G.); Gardner, H.S.

- Installation Restoration provides preliminary pollutant limit values (PPLV) for environmental contaminants to determine cleanup requirements for contaminated sites. Studies are under way by the Food and Drug Administration to determine the subacute and subchronic toxicity of dithiane. This Laboratory is participating in the development of cleanup objectives for Rocky Mountain Arsenal, the former West Virginia Ordnance Works, and Volunteer Army Ammunition Plant. A report has been written defining the cleanup objectives for five contaminants at Cornhusker Army Ammunition Plant. The Army Surgeon General has accepted the values presented in that report. A criteria document for diisopropyl methylphosphate (DIMP), an Army-unique water contaminant, is being brought to completion in consultation with the National Academy of Sciences. This work is supported with funds from the US Army Toxic and Hazardous Materials Management Agency and other reimbursable funding.

In the Field Medical Materiel Development Division, a total of 51 research and development projects were active during FY86; 16 extramural, 32 in-house, and 3 ILIR. Principal FY86 research and development accomplishments under the three FMMDD program management areas as they relate to the USAMBRDL mission area are outlined below:

- In X-ray technology several newly emerging aspects have been investigated. The current field X-ray system, including shielding, power source, and film processing equipment, is one of the bulkiest single items in the field hospital. Toward reducing this bulk and improving efficiency, a flywheel storage power supply was developed that eliminates the need for a large (20 kilowatt) generator, and work was initiated on electrophoretic panel technology development as a means of eliminating the need for film. Concomitantly, the digitization of X-ray images is being investigated to provide a more efficient method of using, storing and transmitting X-ray data. The ultimate combining of these technology pieces into a single field X-ray system will have a profound impact on both the capability and logistical support of the X-ray in the field.

Contracts and Intragovernmental Transfers

Flywheel-Powered Mobile X-Ray Generator with Fluoroscopic Capability; DAOG9379; University of Wisconsin (Siedband, M.P.); Conway, W.H.

Filmless Radiographic System for Field Use; DA309002; University of Wisconsin (Siedband, M.P.); Conway, W.H.

To Develop and Demonstrate a Filmless Radiographic System for Field Use; DA308247; Phillips Laboratories (Murau, P.C.); Conway, W.H.

Digital Radiography Special Studies; DA310469; Uniformed Services University of the Health Sciences (Brahman, S.L.); Hanson, K.L.

Filmless Radiology (Digital Imaging); DA303237; Uniformed Services

University of the Health Sciences (Brahman, S.L.); Sallsbury, L.L.

• The potential for microwave sterilization provides the basis for research with the hope of being able to take advantage of this already well developed technology in place of the cumbersomeness of steam pressure vessels or the use of controversial toxic gases. Information developed thus far shows that microwaves can be used for sterilizing such things as glassware, some plastics and liquids. Metal items present problems of reflectance and a lack of surety exits when sterilizing complex shapes. These issues are being addressed.

In-House Work Unit
Ethylene Oxide Sterilization (EOS) System; DA0G9320; Arnold, M.F.

• A concept study was begun to develop a mobile aid station tracked vehicle ambulance to provide a tracked, armored medical treatment/evacuation vehicle capable of supporting and operating with armored forces on the fluid, ill-defined and highly lethal battlefield postulated in current European scenarios. Appropriate support for these conditions is simply not available at the present time. The vehicles proposed for these roles will be large, based on the XM987 Bradley derivative chassis, and will be able to keep pace with fast moving armored actions. They will be heavily armored to enhance survivability. Basic requirements for the vehicles have been worked out with the combat developments branches of the Academy of Health Sciences and the Armor School, and a plan of action has been worked out leading to the production of brass-board prototypes.

In-House Work Unit
Mobile Aid Station/Ambulance, Tracked, Armored: Concept Exploration; DA309817; Conway, W.H.

• An investigation is being conducted to provide a water recovery/reuse capability for the steam sterilizer now in the inventory (NSN 6530-00-926-2151). The goal is to devise a method to extend the service life of the currently fielded sterilizer, while awaiting the fielding of the Steam Vacuum Pulse Sterilizer currently under full-scale development.

In-House Work Unit
Ethylene Oxide Sterilization (EOS) System; DA0G9320; Arnold, M.F.

• A study was conducted to determine the characteristics of necrotic versus viable tissue with a goal of identifying a technology whereby a discriminating necrotic tissue detector might be developed. This effort began in response to a need expressed by surgeons to have a table-side device that would identify necrosis more reliably than the surgeon's visually backed judgment, and thereby minimize the damage done to vital tissue during wound debridement. The study has thus far concentrated on the electronic signature of necrotic tissue, expanding on impedance measuring work. Other possible

technologies, such as ultrasound attenuation and chemical reactions, will be investigated in this ongoing effort. Toward this end, the Laboratory has been in contact with entomology experts at the University of Illinois to determine the means by which some dipteran larvae identify necrotic tissue.

In-House Work Unit

Necrotic Tissue Detection; DA311265; Dubill, P.A.

• We have moved very rapidly toward fielding a chemical warfare agent protective patient wrap. Current doctrine states that during chemical warfare operations, all casualties will be stripped of the chemical protective overgarments for decontamination; therefore a need was recognized for protection of chemical casualties during evacuation. Available equipment was found to be operationally unacceptable. The USAMBRDL responded immediately to this deficiency with design and development of the Chemical Warfare Agent Protective Patient Wrap. Materials were narrowed from six to two, and design options were tested for optimization. Chemical warfare agent tests of both the design and material indicate that all features of the wrap perform significantly better than the available equipment (the United Kingdom wrap). Physiologic studies of test subjects to environmental extremes are in progress to provide data for establishment of doctrinal guidelines on employment of the wrap during training and combat.

Contracts and Intragovernmental Transfers

Chemical Warfare Agent Protective Patient Wrap; DAOG7067; US Army Natick Research, Development, and Engineering Center (Snow, P.R.); Reams, W.H.

Chemical Agent Testing of the Chemical Warfare Agent Protective Patient Wrap; DA304534; U.S. Army Dugway Proving Ground (Henzelka, J.); Reams, W.H.

• We have the requirement to field an individual, chemical resuscitation device. The primary life threatening reaction associated with nerve agent poisoning is respiratory arrest. Laboratory data indicate that ventilatory support and antidote administration enhances casualty survivability. Therefore, the need for a compact, manually operated resuscitation device was established by the combat developer. The USAMBRDL has designed, fabricated, and tested a device that is capable of maintaining normal blood gases in nerve agent poisoned laboratory animals when used in conjunction with available cricothyroid cannulas. A test bed for pathophysiologic experimentation and efficacy studies has been established at the Uniform Services University of Health Sciences and will be used for subsequent ventilatory studies.

In-House Work Unit

Resuscitation Device, Individual, Chemical, DAOG1512; Reams, W.H.

Contracts and Intragovernmental Transfers

Evaluation of Gas Exchange Capability and Work Requirements of a Hand-Powered Resuscitator for Organophosphate Casualties; New Start; Uniformed Services University of the Health Sciences (Abbrecht, P.H.); George, D.T.

• Our work on the noninvasive NBC warfare patient vital signs monitor is urgent as effective treatment and triage of battlefield casualties are dependent upon the medic being able to accurately measure vital signs. During chemical warfare operations, the protective ensemble effectively prevents determinations of heart rate, blood pressure, and respiratory rates. To address this deficiency the USAMBRDL has developed a Noninvasive NBC Warfare Patient Vital Signs Monitor. Because, the technology did not exist to measure the vital signs in protective clothing, high noise and high vibration environments, new patentable technologies have been developed. This new statometric (patent pending) technology is the only known method which is capable of determining heart rate and blood pressure through the protective ensemble.

Contracts and Intragovernmental Transfers

Development of a Noninvasive NBC Warfare Patient Vital Signs Monitor; DA308748; GMS Engineering Corporation (Samaras, G.M.); Thayer, C.R.

• There is a critical need for a medical grade field oxygen generation and distribution capability in support of Army Medical Department field operations. To fulfill this requirement the USAMBRDL has, on contract, designed, and fabricated a fully operational on-site field medical oxygen generating and distribution system which is scheduled for developmental testing during the 2nd Quarter FY87.

In-House Work Unit

On-Site Medical Oxygen Generating and Distribution System; DA0G9210; Thayer, C.R.

Contracts and Intragovernmental Transfers

Development of Lightweight, High Capacity, Portable Oxygen Systems for Battlefield Medical Support; DA303162; Guild Associates, Inc. (Schlaechter, J.); Thayer, C.R.

A Portable Oxygen Concentrator for Emergency Use; DA303963; Maxdem Incorporated (Marrocco, M.); Thayer, C.R.

• Laboratory data from nerve agent poisoned subjects show that there is a need for a compact powered ventilator for support of nerve agent casualties during evacuation in ground and air ambulances. The combat developer has identified a tri-service requirement for a compact, gas-powered, individual ventilator. To fulfill this requirement, nondevelopment items (NDI) resuscitators have been identified as options. A draft Test Evaluation Master Plan has been prepared and NDI ventilators have been procured for test and evaluation.

In-House Work Unit

Resuscitator/Ventilator, Gas-Powered, Individual (GPV); DA303504; George, D.T.

Contracts and Intragovernmental Transfers

Development of a Multi Frequency Jet Ventilator for Use Under Battlefield

Conditions; New Start; Scientific Research Associates, Inc. (Weinberg, B.C.); Solberg, V.B.

• We continued to provide technical feasibility testing for delivery systems for chemical warfare medicaments. Effective self and buddy aid for the treatment of chemical warfare agent (CWA) poisoning is dependent upon the simple, rapid administration of CWA medicaments. To assure that the antidote delivery systems are safe, effective, and state-of-the-art, engineering evaluations of candidate and prototype delivery systems have been conducted to provide the materiel developer with objective data for selection of the most reliable, acceptable, and cost-effective alternative for administering CWA antidotes for self and buddy aid. The current data base includes a complete engineering evaluation of the Mark I and Mark II autoinjectors. Future studies will include evaluation of three multi-chamber autoinjectors, one of U.S. manufacture and two of foreign manufacture.

In-House Work Unit

Technical Feasibility Testing (TFT) of Delivery Systems for Chemical Warfare Medicaments; DAOG2702; Rhodes, C.T.

• The potential exists for the buildup of toxic chemical warfare agents in a forward medical facility receiving CW casualties. To prevent the incapacitation of medical personnel by low level CWA agents, the USAMBRDL has evaluated the technology data base for development of a medical staff CWA dosimeter. Analysis of the data base indicates that a "real time" individual dosimeter, sensitive to sublethal doses of CWA, is probably beyond the current state-of-the-art. Alternative approaches are being pursued to develop a compact, timed-interval device which will provide total exposure and interval data to medical staff. A continuous effort will be pursued to develop the technical data base required for the fabrication of a real-time, continuous readout medical staff dosimeter. A request for Proposals will be published soon.

• There is a requirement to prevent CWA contamination of open wounds. The current field battle dressing is not chemically hardened and may present a CWA hazard to otherwise treatable wounds. To eliminate this hazard the USAMBRDL has investigated the feasibility of producing CWA protective field battle dressings. To expedite fielding of this new dressing a two phase program has been established. The first phase will provide a chemically impervious overwrap for covering the standard field battle dressing. Options for development of a Phase I overwrap are being developed in conjunction with the U.S. Air Force. The second phase bandage is required to protect and decontaminate any chemical warfare agents that are in the wounds. Alternatives, to include charcoal cloth and charcoal paper, are being pursued by USAMBRDL as options for replacement of the standard field battle dressing. The current data base indicates that incorporation of the charcoal cloth or paper would provide for some decontamination of wounds, protection from outside contamination, and adsorption of bacterial contamination.

In-House Work Unit

Chemical Warfare Agent, Protective Field Battle Dressing; DA307168; Solberg, V.B.

• The pesticide dispersal evaluation set is a "hot-wire" based instrument for rapid measurement of particle size distribution and volume median diameter of insecticide sprays. Characterization of pesticide droplets produced by dispersal equipment is important in pest control operations to obtain optimum cost effectiveness and to prevent possible adverse effects to the environment. Due to the reorganization of Field Preventive Medicine Units, the pesticide dispersal evaluation set is no longer targeted for these units. However, the name was changed to the Army Insecticide Measuring System (AIMS) to ensure Army recognition. It is now commercially available to military installations through local purchase. The instrument has a wide application in laboratory and field research efforts and greatly enhances the Integrated Pest Management - Mosquito and Vector Control Science Base Programs at this Laboratory. The AIMS could also be used in chemical warfare agent defense research.

In-House Work Unit

Pesticide Dispersal Evaluation Set; DA0B6058; Anderson, L.M.

Contracts and Intragovernmental Transfers

Measurement of Droplet Size Distribution in Insecticide and Herbicide Sprays; DA302779; KLD Associates (Mahler, D.E.); Boobar, L.R.

• Technical feasibility testing of commercial pesticide equipment is performed continuously by personnel at USAMBRDL. This program is designed to provide user agencies with comparative durability, reliability, and suitability of the equipment tested. Measurable quantitative parameters include particle size determinations, maintenance of desired flow rate, and ability to kill the target pest. Qualitative investigations include general engineering design for reliability, durability, maintainability, and safety. Definition of high mortality repair parts, gas and oil consumption, and verification of manufacturer's performance specifications are also investigated. During FY86 evaluations, the Micro-Gen G-88, a truck-mounted aerosol generator, successfully completed durability and reliability testing. The Beeco Wispermist, a battery-operated aerosol generator, failed durability testing three times due to an inherent bearing problem in the rotary nozzle. The evaluation of the TIFA 1054 thermal fogger was completed and test results revealed its inability for ultra-low volume dispersal. Three electric dusters, the R&L Atomite, the Micro-Gen E-2 (with dusting attachment), and the B&G 2250, were evaluated to determine their military suitability. The Armitsu H-7 'Tummy' duster was tested against the existing specification at the request of the Defense Construction Supply Center. The duster was operationally adequate, but did not meet all design requirements for the specification. The P.E.S.T. machine, a pneumatic duster for crack and crevice spraying, is undergoing durability testing. A first article test was successfully completed on the LECO MD aerosol generator and the Robco Blow-Mite backpack sprayer/duster. Procurement action was initiated by the U.S. Army Troop Support Command for the LECO MD aerosol generator and by the

Defense Construction Supply Center for the Robco Blow-Mite sprayer/duster. Through the Technical Feasibility Testing Program, state-of-the-art and superior quality equipment was provided to the Department of Defense. Equipment tested included five items for the Armed Forces Pest Management Board, two items for Defense Construction Supply Center, one item for U.S. Army Troop Support Command, and seven items for this Laboratory as part of the development process. This is a 400 percent increase in testing over previous years and had wide ranging impact on readiness of the Army, Navy, and Air Force.

In-House Work Unit

Technical Feasibility Testing (TFT) of Vector Control Equipment; DA0A6296; Sardelis, M.R.

- Vector control methods, materials, and equipment Research, Development Test and Evaluation continued this year. Specifically, tests were conducted on the presently fielded pesticide transfer pump. The gaskets were identified as high mortality items when in contact with pesticides. A Gortex material was tested and proved compatible with pesticides. Documentation was submitted to the specification preparing activity to include the use of Gortex gaskets in pesticide transfer pumps. The Laboratory investigated the type-classified backpack sprayer for possible use as a delouser; the objective is to develop and field equipment with multiple capabilities. Shop drawings for the delouser metering system and nozzle are being finalized. Studies and evaluations of the U.S. Department of Agriculture and Air Force computer models on pest control are under way.

In-House Work Unit

Vector Control Methods, Materiai, Equipment; DA0G8679; Darby, W.H.

- A vector control science base is essential to our program. In FY86 a systematic study to determine the reliability and validity of tests using sentinel mosquito cages as a bioassay tool was initiated. Results obtained when using a conventional wind tunnel and the Army Insecticide Measuring System (AIMS) had high fluctuations. A grid system of air tubes were developed to correct these fluctuations. Preliminary results show a significant lower air velocity at the middle of the tunnel as compared to the two ends. Emphasis on a joint laboratory and field study correlating the amount of ultra-low volume applied insecticide deposited on sentinel cages, as determined by gas chromatographic methods, and the mortality rate of the mosquitoes within the cage is being investigated. Preliminary results show high concentrations of pesticide recovered from cages 100 feet from point of application, and 100 percent mortality of mosquitoes within the cages. The effects of lower application rates and greater trap distances continue to be investigated. Efforts are under way to gain information about the sensitivity of various development stages of Aedes aegypti to Bacillus thuringiensis var. israelensis toxin. Additionally, information about the sizes of protein and peptide fragments of the toxic protein which are responsible for toxicity are being investigated.

In-House Work Unit
Vector Control Science Base; DA0G5997; Perich, M.J.

● During FY86, this Laboratory continued the program in integrated pest management-mosquitoes by a systematic study to develop methods for mosquito control that integrate physical, chemical and biological control methods so as to maintain effective control economically without undue damage to the environment. In addition, efforts were initiated to provide baseline laboratory and field data on the efficacy of various insecticides for control of mosquito larvae from which field application rates and methods will be developed for use by Army Preventive Medicine Units. Further, means are being developed to improve adulticide application techniques specifically designed to optimize control in field situations typically encountered in a Combat Zone. Significant accomplishment during FY86 was the coordination of informational exchange between this Laboratory and the Walter Reed Biosystematic Unit at the Smithsonian Institution on mosquito bionomics and their distribution and control. A comprehensive literature review on the bionomics and control of the major vector species of mosquitoes in Central America was done. A ecological profile on each vector species of mosquitoes is being compiled. A computer program was written and a computerized data base established. This system allows references to be sorted by species, keywords, author, journal and cross-referenced by species and keywords. Two other studies were initiated and investigated; a bioassay of a monomolecular surface film (Arosurf) alone or in formulation with commercial preparations of Bti (Teknar, Bactimos, and Vectobac) against Anopheles albimanus under laboratory conditions and the establishment of two colonies of planaria (Dugesia dorotocephara and Cura foremanii) for studies of their biological control potential. Also a laboratory bioassay of Bti on planaria is in progress in order to determine the possibility of integrating both into a mosquito control strategy.

In-House Work Unit
Integrated Pest Management-Mosquitoes; DA0G0649; Perich, M.J.

ACHIEVEMENTS AND RECOGNITION

EDUCATION

During FY86 an advanced degree in Environmental Biology was conferred upon Mr. Tommy R. Shedd. Sergeant Kyone M. Chen passed all sections of the "Foreign Medical Graduate Examination in the Medical Sciences." Two other staff members continued work on Master's degrees, one in computer science and one in environmental biology. Captain Welford C. Roberts was selected for long-term schooling at the doctorate level. Major John Y. Young completed the Command and General Staff Officer Course.

Two staff members of the Health Effects Research Division, Dr. Gunda Reddy and Dr. Robert A. Finch, were certified by the American Board of Toxicology. Four members of USAMBRDL's scientific and engineering staff were selected to participate in the Combat Casualty Care Course (C4) during FY86. The C4 course is a tri-service, postgraduate medical course presented by the C4 Task Force under the auspices of the Army's Academy of Health Sciences. The course provided USAMBRDL staff members invaluable experience and a new appreciation for direct medical support of tactical units under combat conditions. As a result of USAMBRDL's participation in the course, new approaches are being considered for the resolution of medical materiel problems and deficiencies encountered in the field. Additionally, in FY86, personnel completed professional certification maintenance requirements through professional conferences, workshops, and training courses under USAMBRDL sponsorship.

A total of 69 civilian personnel were trained in 47 courses, and 100 percent of military personnel were trained in 59 courses.

AWARDS

1986 Career Service Award for Fort Detrick Outstanding Scientific Professional Employee:
Dr. William H. van der Schalie (Maryland Honorable Mention)

1986 Career Service Award for Fort Detrick Outstanding Trades or Crafts Employee:
Mr. Leo W. Jenkins (Maryland Honorable Mention)

1986 Career Service Award for Fort Detrick Community Relations:
LTC Thomas E. O'Dell (Maryland Honorable Mention)

Fort Detrick Man of the Year: SGT William H. Darby

Geico Public Safety Award: Mr. Kenneth A. Bartgis

Fort Detrick Soldier of the Year: SGT William H. Darby

USAMRDC Soldier of the Year: SGT William H. Darby

Other awards conferred upon USAMBRDL personnel were:

One military Legion of Merit

Five military Meritorious Service Medals

Four military Army Commendation Medals

One military Army Achievement Medal

Three Commander's Awards

Eight civilian Special Act or Service Awards

Four Career Service Awards

TECHNOLOGY TRANSFER ACTIVITIES

The domestic technology transfer program at the USAMBRDL has been enhanced during FY86 by aligning the program more closely with applicable Army regulations and federal legislation and more thoroughly integrating the technology transfer function into the mission accomplishment of the two research and development divisions. The creation of a USAMBRDL Office of Research and Technology Assessment has given a higher organizational visibility to this function and has resulted in enhanced USAMRDC, Department of the Army, and Federal Laboratory Consortium use of the technical expertise resident at the USAMBRDL.

The development of several technologies has been particularly noteworthy. A device developed for use in pesticide application operations (the Army Insecticide Measuring System) has opened new markets for a small private company. An additional attachment is under development at the USAMBRDL to allow this equipment to be used in other settings, further enhancing the usefulness of this device to the Army. Company officials feel this attachment will offer additional market exposure.

A technology developed by a small business contractor to meet the operational requirements of this Laboratory for testing drinking water has received numerous inquiries from a wide variety of industrial companies. Two patents have been obtained by the company and two are currently pending related to this technology. The requirements and input of USAMBRDL were essential to the successful development of this technology and opened a significant new market for his firm.

The Preliminary Pollutant Limit Value (PPLV) concept developed at the USAMBRDL has been presented to several state and local governments during FY86. This methodology is used to assist in the site specific determination of how clean a site should be, given its intended use and type of pollution present. The PPLV concept is being used by the state of Colorado regarding selected environmental health activities and has been presented in the states of Washington, West Virginia, and Massachusetts.

The USAMBRDL has also been actively involved in utilization of a variety of individuals from academic institutions being employed at the Laboratory. These individuals range in academic background from high school students through tenured university professors. Their work here varied from paid long-term research projects of Army interest to short-term liaison visits and capabilities briefings. The USAMBRDL continues to foster quality research for the Army while providing graduate research projects, summer employment, and sabbatical research opportunities for the civilian academic community.

The academic outreach activity and the dissemination of new and innovative Army medical technology through the USAMBRDL technology transfer program are an expanding and much improved effort of this Laboratory. Due to these efforts, the USAMBRDL technology transfer program has become one of the model programs for the U.S. Army Medical Research and Development Command. With the

advent of markedly increased Congressional emphasis on this program, USAMBRDL will help provide leadership in the technology transfer of the products of Army medical research and development.

Interface with Local Colleges and Universities:

Hood College established an active internship agreement with USAMBRDL to provide students with an opportunity to use their knowledge in a professional setting. In addition, USAMBRDL staff scientists serve as adjunct members of the teaching faculty at Hood College, Frederick Community College, and Georgetown University in Washington, D.C. as well as serving as research thesis advisors.

International Science and Engineering Fair (ISEF) Program:

The USAMBRDL supports the U.S. Army Research Office in the ISEF program which is designed to encourage talented high school students to continue their interests in science, mathematics and engineering. The ISEF program involves scientific competition for high school students in the United States and several foreign countries. USAMBRDL sponsored and provided a research program orientation visit to a 1986 ISEF award recipient.

DOD Science and Engineering Apprentice Program:

In cooperation with The University of the District of Columbia, Washington, D.C., the USAMBRDL provided a summer enrichment program for gifted and talented junior and senior high school students. USAMBRDL has participated in this program for a number of years, designed to involve high school students who have a strong academic preparation in science, mathematics, and engineering in a student-mentor relationship with a scientist or engineer in a research environment. During FY86, five students participated in the USAMBRDL biomedical engineering research study environment.

ASSISTANCE PROVIDED CIVILIAN AND OTHER GOVERNMENT AGENCIES

In response to request from the U.S. Army Medical Materiel Agency, the technical data package used for procurement of the previously type classified High Speed Mini-Sterilizer was verified. Numerous quality control problems with the production sterilizers were identified after deficiencies were noted with the stocked items. This Laboratory's action, performed in a timely fashion, provided the basis for corrective action by the manufacturer.

Consultation and technical guidance was provided to the U.S. Army Medical Materiel Activity for procurement of the Carrier, Litter, Wheeled (Field Gurney) previously recommended for standardization by this Laboratory. The expeditious procurement of the field gurney will drastically reduct manpower

problems associated with moving patients in field hospitals and the field environment. The device is also being considered by Natick Research Development and Engineering Center for the Combat Field Feeding System and potential use for movement of supplies in the field.

At the request of the Academy of Health Sciences, four commercial portable blood storage refrigerators were subjected to a rigorous test program as part of a "fly-off" selection process. A blood refrigerator for the field is an urgent requirement since the noncommercial refrigerator now in the inventory is no longer supportable. Data on the four refrigerators tested were submitted to the Combat Developer (AHS) for consideration in nondevelopment item (NDI) procurement.

A Memorandum of Understanding (MOU) between the USAMBRDL, the U.S. Army Medical Materiel Development Activity, and the 1st Special Operations Command (Airborne) was signed in June 1986. This document clarifies and amplifies the coordination and support roles provided by each command in transfer of the French Parachutist Surgical Unit (FPSU) to the 1st Special Operations Command (Airborne) for evaluation testing, exploitation, and potential contingency use.

The Defense Construction Supply Center designated the USAMBRDL as the primary laboratory for performance of first article test of all items procured by the Center under Federal Supply Class 3740.

A study was performed for the Defense Personnel Support Center to determine the efficacy of a value engineering proposal on the Medical Unit Self-Contained Transportable (MUST) Bed Service Stand. The study verified the adequacy of the proposed cost saving modification.

A field surgical light, a component of the French Parachutist Surgical Unit (FPSU), was evaluated from a design and operational point of view and found to be superior to the current light in the U.S. inventory. Data were provided to the Defense Medical Standardization Board for standardization.

The USAMBRDL provided the necessary staff to compile the Pest Control Equipment Catalog (155 pp). This catalog was compiled in response to a need for a descriptive reference on standard available field pest management equipment.

Equipment, training, and technical assistance on the aerial dispersal of pesticides was provided to the DoD in the following ways:

- Instructors and equipment are furnished to the DoD aerial spray course conducted annually at Rickenbacker Air National Guard Base, Ohio.

- Equipment was furnished to the U.S. Military Academy at West Point, New York, for use in suppression of gypsy moths. Personnel from West Point received training on the equipment prior to spray missions.

- Information is provided to all three services on all types of equipment. The amount and types of information requested during FY86 increased 200 percent over the previous year.

A Memorandum of Understanding between U.S. Environmental Protection Agency (USEPA) and the Department of the Army (DA) on cooperative research and development was completed. The objective of this MOU is to establish policies and administrative methods that will permit cooperation and coordination between the USEPA and the DA in research and development for pollution abatement and environmental quality management. The purpose of the cooperation and coordination is to avoid duplication in research and development programs, and permit USEPA utilization of Army owned facilities and property in testing, evaluation, and demonstration of technology developments. A subsequent MOU between the DA and the USEPA on "Development of Drinking Water Health Effects Advisories for Army Environmental Contaminants" was signed FY86. This agreement specifically delineates the responsibilities and procedures under which the USEPA and the DA and their subordinate offices will cooperate in the development of interim water quality guidelines related to military-relevant contaminants generated by Army peacetime activities within the boundaries of the U.S. and its territories.

Based on visitor exchange, briefings and dialog between USAMBRDL and the Canadian Defense and Civilian Institute of Environmental Medicine (DCIEM), Toronto, Canada, staff in 1981, a formal Memorandum of National Defense (DCIEM lead) was established concerning "A Cooperative Arrangement to Exchange Information on the Habitability of Armored Fighting Vehicle Systems." Principal MOU focus is on occupational exposures of armored vehicle crew members to potentially toxic hazards.

A Memorandum of Understanding was established between the Project Manager, Smoke/Obscurants, the U.S. Army Chemical Research, Development, and Engineering Center (CRDEC), and USAMBRDL for smoke and obscurants toxicology research. This agreement delineates operational and support relationships between Project Manager, Smoke/Obscurants (PM Smoke); CG, CRDEC; and Commander, USAMBRDL, in the performance of toxicology studies on smokes and obscurants.

A Memorandum of Agreement between the USAMRDC and the U.S. Army Troop Support Command (TROSCOM) was updated this fiscal year. The USAMBRDL has been designated configuration management responsibility for processing all actions between USAMRDC and TROSCOM. This document clarifies and amplifies the coordination and support roles by each command in the fielding process for Insect and Rodent Control Equipment projects in the Federal Supply Class 3740. The MOA is applicable to Army managed items/systems which are assigned to USAMRDC for research, development, engineering, first production procurement, and follow-on engineering support of transitioned items. The TROSCOM will provide logistics, readiness support, and acquisition after transition of the project.

Cooperative research was initiated with the National Cancer Institute on a composite study of drinking water carcinogens and mutagens utilizing aquatic animals as bioassay animals. This research validates the efficacy of less costly animal models in the evaluation of carcinogens and mutagens. The utility and sensitivity of fish (marine and freshwater) to drinking water carcinogens have been determined.

The USAMBRDL participated in the Toxicological Panel Subcommittee of the Joint Army, Navy, NASA, Air Force Committee (JANNAF). This panel collects, evaluates, disseminates, and exchanges information relative to safety and environmental hazards criteria and operational procedures for manufacturing, handling, transporting, storing, and testing propellants and propulsion systems. Requirements for research are recommended.

a. A collaborative program with the U.S. Food and Drug Administration was developed which focuses on interlaboratory testing of an aquatic microcosm protocol.

b. The USAMBRDL jointly supported an interagency effort with U.S. Environmental Protection Agency to develop and validate a static renewal chronic toxicity test with the aquatic invertebrate Daphnia magna; to participate in a USEPA-sponsored peer review panel to evaluate a standardized chronic toxicity testing procedure for the aquatic invertebrate Daphnia magna; and to develop new methodologies in aquatic toxicology.

c. Technical meetings involving formal presentations were held during the year, focusing on an overview of Federal Agency Research on carbon monoxide and improved modeling of carboxyhemoglobin formation utilizing the Coburn-Foster-Kane equation.

A USAMBRDL staff member, Major David T. George, Chief, Chemical Defense Materiel Branch, served as the Task Area manager to the Commander, U.S. Army Medical Research Institute of Chemical Defense, for Chemical Casualty Care Equipment.

Colonel Gerald B. Goethals, AN, USAMBRDL Staff Nurse, served as the Consultant to The Army Surgeon General in Operating Room Nursing.

The Naval Surface Weapons Center-Dahlgren Laboratory was provided technical support and materiel for use in a casualty decontamination exercise aboard the U.S.S. Saipan.

The Laboratory provided final technical and engineering design options to Natick Research, Development and Engineering Center for initial production run of the Chemical Warfare Agent Protective Patient Wrap.

The Laboratory cooperated extensively with the U.S. Army Medical Materiel Development Activity in providing technical support for the development of Life Cycle Management documentation for 6.3B and 6.4 projects.

Two staff members of the Health Effects Research Division provided expert consultation to the Department of Justice in litigation concerning chemical substances involved in installation cleanup at Rocky Mountain Arsenal.

OTHER TECHNICAL EXCHANGE

Technical Meetings Sponsored:

Dr. Gary Phipps, U.S. Environmental Protection Agency, Environmental Research Laboratory, Duluth, MN; "Predicting Human Lethal Blood Concentrations with Rainbow Trout."

Mr. Lennarth Holm, Chief Materiel Development and Testing, Medical Board of the Swedish Armed Forces attended a cold weather medical materiel symposium, hosted by USAMBRDL, 28-29 January 1986. The purpose of the visit was to discuss items of mutual medical materiel interests--such as the Swedish Army Heated Casualty Evacuation Bag and other cold weather equipment. The Swedish Armed Forces are interested in our technology concerning blood handling, infusion techniques, breathing assistance and oxygen treatment, and stretcher standards. Based upon visitor exchange briefings and dialog among the U.S. Army Medical Bioengineering Research and Development Laboratory and the U.S. Army Research Institute of Environmental Medicine, Medical Department Activity Alaska, Academy of Health Sciences, and Mr. Holm, an informative interchange of technologies and cold weather medical materiel deficiencies took place.

Dr. Keith Cooper, Rutgers University, E. Brunswick, N.J.; "The Use of the Japanese Medaka Embryo-Larval Assay for Detecting Teratogenic and Carcinogenic Materials in Environmental Samples."

Dr. Dick Pratt, Virginia Polytechnical Institute and State University, Blacksburg, VA; "Responses of Multispecies Aquatic Test Systems to Pure Compounds and Complex Mixtures."

Dr. Donald W. Misch, University of North Carolina, Chapel Hill, NC; "Mucociliary Transport in Frog Oral Epithelium."

Dr. Paul H. M. Lohman, The Netherlands; "Immunochemical and Biochemical Methods Suitable for the Molecular Dosimetry of Effects Resulting from Genotoxic Exposure of Humans."

Dr. Richard M. Kocan, University of Washington-Seattle, Seattle, WA; "Fish Cell Culture: Long-Term Genetic Damage Indicator for Mutagens and Carcinogens."

Dr. Stratford H. Kay, Corps of Engineers, Waterways Experimental Station, Vicksburg, MS; "Organic Contaminants in Sediment and Bulrushes from a Dredge Material Disposal Site."

Dr. Wayne Landis, U.S. Army Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD; "Organofluorophosphate Hydrolases in Tetrahymena thermophila."

Dr. Millie Hughes-Fulford, NASA Life Sciences, Johnson Space Center, Houston, TX; "An Overview of Spacelab Life Sciences One and Two."

Consultation and Foreign Exchanges:

Dr. James H. Nelson, Chief, Field Medical Materiel Development Division (FMMDD), presented the U.S. Army Medical Bioengineering Research and Development Laboratory's medical research and development program at the U.S.-Israel Bi-lateral Symposium on Medical Research and Development in Shoresh, Israel, December 1985. Dr. Nelson also visited Stockholm, Sweden, in June 1986 to attend the 2nd International Symposium on Protection Against Chemical Warfare Agents.

VISITORS TO USAMBRDL

11 Oct 85: Walter Reed Army Institute of Research, Military Medical Science Fellows: LTC Lawrence Agodoa, LTC Philip Chan, LTC Thomas Brewer, MAJ Charles Davis, and MAJ Kip Hartman.

17 Oct 85: BG Zhuang Ming-Fa, Army Attache, Embassy of the People's Republic of China.

5 Nov 85: MAJ Jean Louis Belard, Defense Medical Advisor, Office of the Armament Attache, Embassy of France.

6 Nov 85: Brigadier Nail Ajluni, Deputy Director, Royal Medical Services, Jordanian Armed Forces.

26 Nov 85: Dr. J.A. Cotruvo (and staff), Director of Criteria and Standards, Office of Drinking Water, U.S. Environmental Protection Agency.

4 Dec 85: Dr. Wang Guang-Liang, President, Dr. Yin Mu-Guan, Deputy Director, and Associate Professor of Pharmacology and Dr. Yue Tian-Li, Associate Professor of Pharmacology, 2nd Military Medical College, Shanghai, China.

11 Dec 85: BG Robert Buker, Deputy Surgeon General, U.S. Army.

11 Dec 85: COL Richard Proctor, U.S. Army Training and Doctrine Command.

19 Dec 85: Dr. J. Jarrett Clinton, Deputy Assistant Secretary (Professional Affairs and Quality Assurance), Office of the Assistant Secretary of Defense (Health Affairs).

10 Jan 86: LTG Quinn H. Becker, The Surgeon General, U.S. Army.

3 Feb 86: Dr. Daphne Kamely, U.S. Environmental Protection Agency.

13 Feb 86: COL Ann Marie Goransson, Medical Director, Northern Medical Command, Armed Forces of Sweden.

6 Mar 86: MAJ A. W. Sweeney, Royal Australian Army.

24 Mar 86: USAMMA Medical Materiel Management Course students: MAJ Bruce Molitor, CPT Thomas F. DeFayette, CPT Ray Nickell, Jr., CPT Alan C. Shero, and CPT Mark L. Silkwood.

9 Apr 86: MG Silvio Alva, Director of the Central Military Hospital, Peru, COL Luis Guevara, COL Carlos Johnson, LTC Cirilo Bautista, LTC Jose Hernandez, MAJ Jorge Moscol, and MAJ Juan Velasco.

18 Apr 86: Richmond High School and College Educators (15 total).

2 May 86: Spring Review: Mr. Keith Charles, Deputy for Programs, Assistant Secretary of the Army (Research, Development and Acquisition), and COL John Vester, U.S. Army Reserve.

20 May 86: USAF Residents in Aerospace Medicine, Brooks Air Force Base, TX: LTC Douglas Dowville, LTC Louis Royal, MAJ Sharon Falkenheimer, and MAJ Mark Swedenburg.

30 Apr 86: MG Jung-Soo Choi, COL Tae-Ui Hong, COL Sung-Soo Huang, LTC Kyu-Yun Yoo, LTC Sung-Dae Cho, Dr. Jung-Bu Kang, and COL Sang-Ho Do, Headquarters, The Armed Forces Medical Command, Republic of Korea, Seoul, Korea.

22 May 86: MG David M. Roberts, Director of Army Medicine, Ministry of Defence, United Kingdom, and COL Ian S. Creamer, British Medical Liaison Officer, British Embassy.

25 Jun 86: MG (Ret.) Pierre Ricaud, Special Advisor to the Minister of Defense, France, and Mr. Michel Brochier, Chairman of the Board, TMB Co.

15 Jul 86: Dr. Susumu Sekiguchi and Dr. Shimi Katasuji, National Defense Medical College, Japan.

16 Jul 86: Members of American Registry of Professional Entomologists.

23 Jul 86: BG Peter D. Hidalgo, Commander, Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD.

22 Aug 86: Dr. David J. Howells, Ministry of Defence, Chemical Defence Establishment, United Kingdom.

6 Aug 86: Professor Hu, Research Professor, Shanghai Institute of Physiology, China.

26 Aug 86: Walter Reed Army Institute of Research, Military Medical Science Fellows: LTC Lawrenc Agodoa, COL James Arthur, COL William Madden, and CPT Wiley Smith.

PUBLICATIONS

The USAMBRDL research and development efforts led to the publication of 24 manuscripts in professional journals, 24 presentations, and 41 in-house publications (technical reports). USAMBRDL sponsored extramural research led to 96 publications and study reports.

Open Literature Publications:

1. Bausum, H.T., S.A. Schaub, C.S. Clark, and V.A. Mayeti. 1986. Potential Health Effects from Airborne Viable Emissions and Toxins Associated with Wastewater Treatment Plants and Land Application Sites. Invited review paper submitted, July 1986, to Critical Reviews in Environmental Control.

2. Bell, B.A. and W.D. Burrows. 1986. Removal and Degradation of TNT in a Semicontinuous Activated Sludge System. Submitted to Water Research.

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